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Predictors of Mortality Among Patients with Leakage Following Gastric Perforation Repair: Case Series and Recommendations from A Limited Resource Setting in Western Uganda

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1. Abstract

1.1. Introduction

Peritonitis originating from perforation of a hollow viscus deserves special attention, more so when a repair failure from a previous emergency laparotomy results in leaked repair.

1.2. Materials and Methods

We prospectively followed up and analyzed the medico-surgical outcomes of 8 patients who underwent graham patch repair following perforated gastric peptic ulcer and managed in the department of surgery between 30 April to 15 July 2024 at Fort-portal regional referral hospital in western Uganda.

1.3. Results

This prospective study aimed to assess the outcomes of Graham patch repair for perforated peptic ulcer disease (PPUD) in a low-resource setting. Among 8 patients, 5 (62.5%) developed postoperative leaks. Key risk factors for leaks included delayed presentation (over 48 hours), immunosuppression, anemia, and elevated creatinine levels. The Mannheim Peritonitis Index (MPI) was >21 in all patients, with 60% scoring >26, indicating a high risk of mortality. Mortality occurred in 3 out of 5 patients with leaks.

1.4. Discussion

Peritonitis following gastric or duodenal perforation carries a high risk of mortality, especially after failed repairs. Contributing factors included anemia, renal dysfunction, and immunosuppression. The lack of laparoscopic services further limited effective management. Early diagnosis and improved perioperative care are essential to reduce these poor outcomes in resource-limited settings.

1.5. Conclusion

Early leak detection, early surgical intervention, and better pre-operative management are critical to improve patient outcomes in a limited resource setting in Uganda.

2. Introduction

Gastroduodenal perforation (GDP) is a highly lethal surgical emergency with previously reported a significant mortality as high as of 10–40% [1, 2]. Worldwide, approximately 250,000 deaths are related to peptic ulcer disease (PUD), of which 70% are accounted for by GDP [1]. PUD is the most common etiology of GDP, which is prevalent in both sexes regardless of age. This may be related to smoking and the use of ulcerogenic drugs [3]. Primary open repair with pedicled omental patch remains the mainstay of treatment, although a laparoscopic approach, first described in 1990 [4], has also been widely adopted [5]. The modified Graham patch has thus become universally accepted due to its simplicity, ease of execution, reduced operation time and overall reduction in adverse postoperative outcomes (2, 5, 6). However, its major drawback is related to postoperative leakage and subsequent generalized peritonitis (1, 3-7).

Various studies including randomised controlled trials and subsequent meta-analyses have compared the two techniques (open modified Graham patch and laparoscopic); similar morbidity and mortality were observed [6, 7]. A recent prospective study demonstrated a figure of eight primary closure with omental flap reinforcement to be more superior than Graham's omentoplasty (plugging) in terms of decrease leaked repair rate in perforations <2 cm in diameter [8]. Poor surgical outcome has been linked to perioperative shock, treatment delays>24 h, larger perforation size, old age and the presence of major co-morbidity [9].

Rather than engaging in search of more elaborate procedures with less leakage rates after repair, strategies and studies to improve understanding of the complex clinic-pathologic elements and technical errors associated with high leaked repair rates will be salutary [5, 7, 8].

A fast and less invasive procedure is particularly relevant and preferred in a resource-constrained setting like ours where patients commonly come to hospital late, often in shock, and with high American Society of Anesthesiologists scores (III-V).

The aim of this study was to analyze the various predictors of mortality after leaked repair (Modified Graham Patch) of GD perforation and document or assess the different techniques of management and outcome of established cases of leaked repair in our setting. We are reporting a series of 5 cases of leaked repair of GD perforation patient and their outcome managed in a limited resource setting.

3. Case Series

We prospectively followed up and analyzed the medico-surgical outcomes of 8 patients who underwent Modified Graham patch repair following perforated gastric peptic ulcer and managed in the department of surgery between 30 April to 15 July 2024 at Fort-portal regional referral hospital in western Uganda. Only the 5 patients who have leaked repair were included in our study according to inclusion criteria.

Demographic profile, past medico-surgical history, clinical presentation, laboratory parameters (Table 1), preoperative parameters analyzed (Table 2). Prognostic factors, Mannheim peritonitis index (MPI) [10]. Were recorded accordingly (Table3). Surgery details and intraoperative findings (type of surgical repair, size of perforation, location of the perforation), and outcome was analyzed (Table 4) described below.

Patients were followed up regularly in surgical ward every day, with clinical examination and hemogram levels every 2 days. Abdominal X-ray and ultrasound scan were done for all patients, and a non-contrast abdomen CT scan was performed only for 1 patient and showed air under the diaphragm with dilated bowel (Figure 1). There were five patients who fulfilled our inclusion criteria with age range from 17-60 years; 1 female and 4 males.

One patient had a negative *H. pylorus*, and other four positive *H. pylori*. No patient had a gastric mass. Only one histopathology was positive for malignancy in the 45-year-old male patient. All patients were referred from other hospitals and among them 3 came after the initial operation had already been done (exploratory laparotomy performed then referred for further management after severe SSI discovered on days 7 post- operative, before the second laparotomy at the referral hospital). All patients were on medication for *Helicobacter pylori* infection before the perforation, two taking pylor kit orally (clarithromycin 250mg, Lanzoprazole 30mg, and tinidazole 500mg) and other three patients on oral omeprazole capsule 20mg for long duration.

Three (3) with abdominal distension. Location of the perforation is shown in table 4 with others parameters. All patients had gastric perforation and the modified Graham patch was performed during the first laparotomy (Gastric repair). At the second laparotomy, 3 of them underwent again direct Modified Graham patch after refreshing edges of the perforation, and 2 underwent modified Graham patch after 7 days of delayed abdominal wound closure using the Bogota technique.

In the post-operative follow up, the 2 patients who survived, were managed with oral pylor kit (clarithromycin 250mg, Lanzoprazole 30mg, and tinidazole 500mg) for 7 days, and long-term medication of oral omeprazole 20mg for 2 months and these patients improved. The Mannheim Peritonitis Index (MPI) is a scoring system with prognostic value among patients with peritonitis, especially predicting mortality [10, 12]. The MPI (Table 3) was applied along with other clinical and parameters recorded. Prediction was categorized into 3 groups: i) score ≤ 20 (low risk), ii) Score 21-29 (moderate risk) iii) score ≥ 30 (High risk). Further resuscitation and ICU care was given as and when was necessary. Patients were followed up postoperatively till the outcome i.e. mortality, morbidity or discharge [10, 11, 12]. The MPI takes into account age, gender, organ failure, cancer, duration of peritonitis, involvement of colon, and extent of spread and character of the peritoneal fluid. Patients with a score exceeding 26 were defined as having a high mortality rate. Outcome and clinical course of those studied patients were reviewed and analyzed.

**Pylor Kit: is a combination medicine used in the treatment of peptic ulcer disease by relieving the symptoms (it combines lansoprazole, clarithromycine and tinidazole).

Table 1: Laboratory parameters of cases on admission before the second Laparotomy.

Lab parameters	**Patient**				
	Patient one	Patient two	Patient three	Patient four	Patient five
Age	45Year	40Year	17Year	23Year	60Year
Sex	Male	Male	Female	Male	Male
Hemoglobin, g%	7 g%	6 g%	7 g%	9 g%	7.5 g%
White blood cells,/mm^3	21 000 cells /mm^3	16 500 cells /mm^3	17 500 cells /mm^3	18 900 cells /mm^3	22 000 cells /mm^3
Platelet /Microliter of blood	62 000 platelet/ Microliter of blood	100 000 platelet/ Microliter	160 000 platelet/ Microliter	170 000 platelet/ Microliter	120 000 platelet/ Microliter

Creatinine mg/dL	1.8 mg/dL	2.3 mg/dL	3 mg/dL	1.4 mg/dL	3.2 mg/dL
ESR mm/Hour	92 mm/ hour	112 mm/ hour	56 mm/ hour	110 mm/ hour	14 mm/ hour
HIV	Positive	Positive	Negative	Positive	Positive
RBS mg/dL	117 mg/dL	106 mg/dL	86 mg/dL	131 mg/dL	152 mg/dL
H. pylori	Positive	Positive	Negative	Positive	Positive
Histopathology	Gastric cancer (adenocarcinoma)	Benign	Benign	Benign	Benign

RBS: Randomized blood sugar, *H. Pylori: Helicobacter Pylori*, ESR: Erythrocyte sedimentation Rate.

Table 2: Pre- operative parameters.

Parameters	Patient				
	Patient one	Patient two	Patient three	Patient four	Patient five
Days spent before the second laparotomy surgery (discovering leakage)	3 days	3 days	6 days	4 days	5 days
Shock before the second laparotomy	Yes	Yes	No	No	No
SSI	Yes	Yes	No	Yes	Yes
MPI*	37	42	22	24	36
Chronic disease apart PUD	Yes	No	No	No	Yes
Previous surgery	No	No	No	No	Yes
Previously on Pylor Kit**	Yes	Yes	No	No	Yes
Referred from another hospital	Yes	No	Yes	Yes	No
First sign observed	Fever, abdominal distension	ECF	Fever, abdominal distension	Entero-cutaneous fistula	Abdominal distension
Vital signs (Temperature, Heart rate, blood pressure, Respiratory rate and SPO2)	Instable	Instable	Stable	Stable	Instable
Level of the first operator	Surgeon	Medical officer	Medical officer	Resident in general surgery	Resident in general surg

SSI: Surgical site infections, PUD: peptic ulcer disease.

Table 3: Mannheim Peritonitis Index (MPI).

Risk factor	**Weightage, if any**
Age > 50 years	5
Female gender	5
Organ failure *	7
Malignancy	4
Preoperative duration of peritonitis > 24 hours	4
Origin of sepsis not colonic	4
Generalized peritonitis	6
Exsudates	0-12 (clear, cloudy or purulent and fecal)
Clear	0
Cloudy, purulent	6
Fecal	12

*Definition of organ failure: kidney: creatinine >117µmol/L, urea >167 µmol/L, oliguria <20 ml/h, for lung po_2<50 mmHg, pCO_2>50mmHg.

Table 4: Intra- operative findings.

Parameters	Patient				
	Patient one	Patient two	Patient three	Patient four	Patient five
Leakage location	Antrum	Body	Fundus	Fundus	Body
Skin closure, Bogota or all layers	Bogota bag technique	Bogota bag technique	All layers closure	All layers closure	Bogota bag technique
Used of abdominal drain	Yes	yes	No	No	No
Level of the second operator	Surgeon	Surgeon	Surgeon	Resident in surgery	Surgeon

Table 5: Post- operative data (Post the second laparotomy).

Parameters	Patient				
	Patient one	Patient two	Patient three	Patient four	Patient five
Hospital stays (days)	13	11	7	17	5
Post op pylor kit	No	No	Yes	Yes	No
Post op Omeprazole	Yes	Yes	Yes	Yes	Yes
Antibiotics given	IV PISA and IV metronidazole	IV PISA and IV metronidazole	IV Ceftriaxone and IV metronidazole	IV PISA and IV metronidazole	IV PISA and IV Metronidazole
Outcome post the second laparotomy	Death	Death	Discharged home	Discharged home	Death

PISA: Piperacilline- Tazobactam, IV: Intravenous.

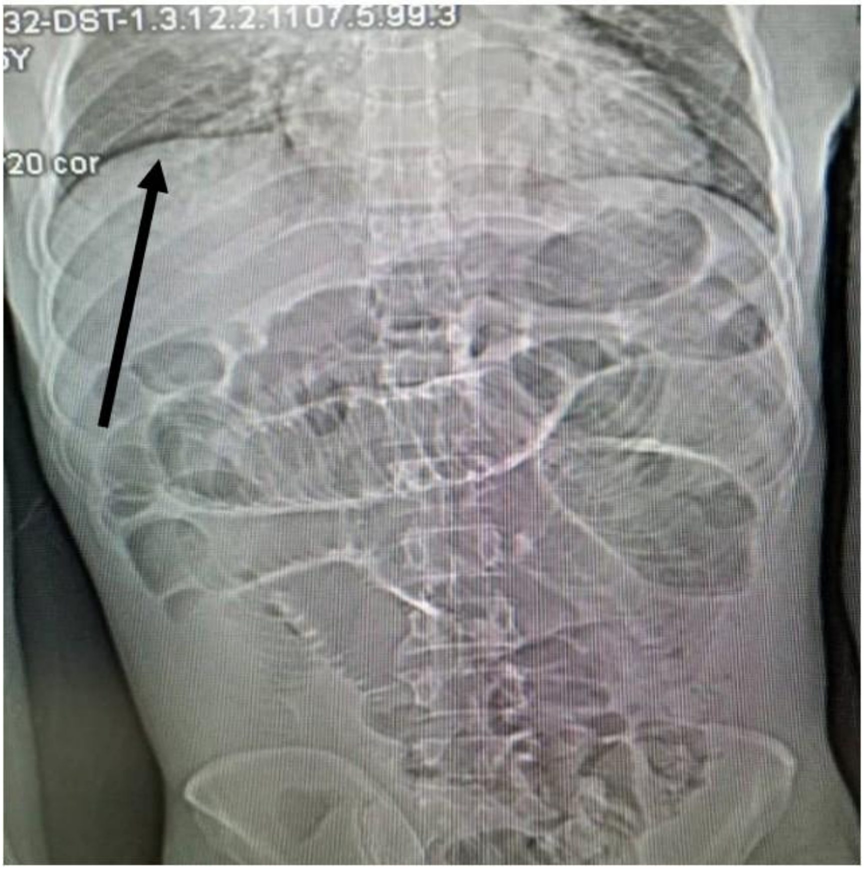

Figure 1: A non-contrast abdomen CT scan showing air under the diaphragm with dilated bowel.

4. Discussion

Peritonitis caused by the perforation of a hollow organ requires particular attention, especially when a previous emergency laparotomy has failed, leading to a leak at the repair site. Although the traditional pedicled omental patch remains the standard method for repairing gastroduodenal perforations due to peptic ulcer disease, reported rates of repair leaks range from 8% to 16%, with mortality rates reaching 10% to 15% [13, 14]. In contrast, our study found that 60% of patients with a failed initial repair died following a second attempt at repair. Leakages after laparotomy for perforated peptic ulcer disease (PPUD) are a widespread issue, though the incidence varies by geographic location [5, 15]. Reported rates in various studies range between 3% and 30% [5, 15, 16, 17].

Re-laparotomy after a failed repair carries higher surgical risks and is often technically challenging [6, 14]. In a Danish study of 726 PPUD cases, 17.1% required re-laparotomy, with persistent leakage as the leading cause [5]. Leak rates vary globally: 14.0% in Ethiopia [15], 11.3% in Pakistan [16], 10.9% in India [17], and as low as 4.0% in Iran [18], while higher rates have been reported in eastern DR Congo [19]. In our study, 62% (5/8) of patients who had Modified Graham patch repair experienced leakage, likely due to the inclusion of only Modified Graham's patch cases.

Effective management of PPUD complications depends on various factors, including surgeon expertise, access to laparoscopic services, and patient demographics [20, 21]. In our setting, only open surgery is available due to lack of laparoscopic equipment and trained personnel. The average age of patients with repair leaks in our study was 36 years, compared to 53.3 years in similar cases reported from Pakistan [16], suggesting a younger affected population in our cohort.

Although our study found no significant association between age and repair leakage (Table 1) [22, 23], several clinical factors were linked to poor outcomes. Intra-abdominal infections remain particularly challenging in patients with anemia, elevated creatinine, immunosuppression, delayed presentation, sepsis, or shock [23–25]. In our cohort, 60% had a Mannheim Peritonitis Index (MPI) >26, indicating high mortality risk, and all had MPI >21, reflecting at least moderate risk [10, 11, 19, 26]. Immunosuppression (4/5 patients) and delayed surgical consultation (>48 hours in all cases) were strongly associated with repair leaks and mortality (3 deaths out of 5 leaked repair). Similar findings have been reported in studies from Pakistan, Egypt, Nigeria, Ethiopia, and the Netherlands [6, 15, 17, 22, 27].

Despite ongoing debate around re-laparotomy for leaks [16, 28], multiple factors consistently correlate with poor outcomes: older age (mean 36 years in our study, range 17–60), malignancy (1/5), immunosuppression (4/5), preoperative hypotension (2/5), anemia (Hb <9 in all), elevated creatinine (all), and *H. pylori positivity* (4/5) [3, 29]. Key predictors of mortality after repair leaks include shock at admission, HIV/AIDS, age over 60 years, and delayed treatment (>24 h) [30–32]. Gastro-duodenal ulcers carry a 2–3 times higher mortality risk, rising to 50% in the elderly due to comorbidities and diagnostic delays [6, 31]. Friable tissues and failed primary repairs often make re-suturing difficult, making resection a safer alternative in select cases [32, 33].

CT imaging is better to detect postoperative leaks than to leave an abdominal drain to assess the output [31, 32]. The modified Graham patch remains widely used for its simplicity, short operative time, and favorable outcomes [6]. In low-resource settings like ours, simple closure with omental patch is the standard approach. Yet, despite advances in anesthesia and surgical techniques, postoperative morbidity remains high (20–50%), with mortality rates of 3–40% [8, 34, 35].

5. Literature Review

Graham's omental patch (omentopexy) has long been the standard, favoured for its simplicity and short operative time in emergency repair of perforated peptic ulcers; numerous reviews and cohort studies report acceptable overall outcomes but note persistent leak and mortality risks that vary widely by setting (reflecting patient condition, delay to surgery, and local resources) [36, 37]. Comparative cohort data indicate leak rates commonly between ~4% and >10% and mortality spanning single digits to >20% in sicker cohorts, highlighting that technique alone does not eliminate risk when patients present late or in shock [38, 39].

Trials and prospective comparative series that directly evaluate Graham versus modified Graham techniques generally find small but clinically relevant differences in some perioperative outcomes. Randomized and quasi-randomized studies report comparable overall safety but suggest modified Graham approaches (which include variations such as anchoring sutures, altered omental positioning, or reinforcement stitches) can reduce operative time, postoperative pain, hospital stay, wound complications, and, in some series, leak rates [40, 41]. However, many studies are single-center, underpowered for mortality endpoints, and heterogenous in how the "modified" technique is defined, limiting firm conclusions about survival benefits [40, 41].

Beyond direct technique comparisons, recent prospective work has explored alternative closure methods (e.g., figure-of-eight primary closure with omental flap) and context-specific choices (omentopexy, plugging, or resection for large/friable defects), with some trials showing lower leak rates for certain modified closures in small perforations (<2 cm) [8, 36]. The overall evidence therefore supports that (a) modified Graham variants can improve short-term morbidity and resource use in many centres, (b) choice of repair should be individualized by perforation size, tissue quality and patient risk, and (c) high-quality multicenter randomized trials are still needed to determine whether any technique confers a reproducible mortality advantage across diverse, resource-limited settings [38, 39].

6. Conclusion

This study highlights that mortality following leaked repair of gastric perforations remains high in low-resource settings, primarily driven by preventable risk factors such as delayed presentation, anemia, elevated creatinine, immunosuppression, and high Mannheim Peritonitis Index scores, remain major contributors to poor outcomes. The findings emphasize the urgent need for early diagnosis, improved perioperative care, and risk-based management to reduce adverse outcomes. Addressing systemic challenges, including limited diagnostic capacity, inadequate surgical expertise, and delayed referrals, is critical to improving survival rates in patients with perforated peptic ulcer disease (PPUD) in similar contexts.

Strengthening the surgical ecosystem through early detection, multidisciplinary collaboration, and improved perioperative support can substantially reduce morbidity and mortality in resource-limited environments.

7. Key Clinical Recommendations

Adopt routine use of the Mannheim Peritonitis Index (MPI) to guide perioperative decision-making and identify high-risk patients requiring intensive monitoring.

Optimize preoperative patient stabilization, correcting anemia, renal dysfunction, and sepsis before surgery whenever possible.

Strengthen surgical capacity, community-level awareness and referral systems by improving access to diagnostic imaging, laparoscopic tools, and continuous training for surgeons in resource-limited settings.

Then e**nsure early recognition and prompt surgical intervention** for suspected gastric perforations to minimize the risk of repair leaks and mortality. Educating primary healthcare workers and the public about early warning signs of peptic ulcer perforation and complications can shorten prehospital delays and improve early presentation rates.

Introduce nutritional and infection control programs: Routine nutritional screening and early enteral or parenteral supplementation, along with strict perioperative antibiotic stewardship and infection prevention practices, can reduce postoperative complications.

Develop multidisciplinary "acute care surgery teams": Collaboration among surgeons, anesthetists, internists, and critical care nurses should be institutionalized to provide coordinated care for complex peritonitis and leak cases.

Establish regional surgical audit and morbidity review systems: Regular case audits and data sharing across regional hospitals can identify common technical errors, improve decision-making, and foster quality improvement in emergency surgery.

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