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ORIGINAL CONTRIBUTIONS

Marginal Ulcers Following One-Anastomosis Gastric Bypass: a Systematic Review and Meta-analysis

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Abstract

Background Marginal ulcer (MU) is an uncommon but significant complication following one-anastomosis gastric bypass (OAGB). Our study aims to understand the incidence rates, risk factors, and management of MU following OAGB.

Methods MEDLINE, Scopus, and Cochrane Library databases were examined to identify all studies on OAGB where authors had reported on MU. Data were collected on basic demographics, incidence rates, risk factors, and management of this condition.

Results Thirty-two studies involving 8868 patients were analysed. The mean age and body mass index (BMI) of patients in these studies were 40.9 ± 4.5 years and 47.6 ± 5.6 kg/m^2, respectively. Among the patient cohort, approximately 72% were female, and 20.6% had preoperative gastroesophageal reflux disease (GERD). The authors described prescribing proton-pump inhibitors (PPI) prophylaxis to 14.1% of patients after surgery. Two hundred twenty-eight patients were reported to have MU. The incidence of MU was 2.59% (95% CI 1.89–3.52), of which 53 patients presented within 12 months, 24 patients presented after 31 months, and five patients after 6 years. One hundred forty-six patients did not have presentation time documented. Sixty-five patients were described to have MU diagnosed on endoscopy, of which 54 were symptomatic and 11 were asymptomatic. The authors were, however, not specific on the choice of investigation for the remaining 163 patients. Of patients, 89.7% were treated conservatively with PPIs, whilst 10.3% had surgery to treat MU.

Conclusions Marginal ulcer is an uncommon complication following OAGB. The majority of patients are treated conservatively with PPIs. Larger, well-designed studies reporting on risk factors, investigation, and management of MU following OAGB are warranted.

Keywords Marginal ulcers · One-anastomosis gastric bypass · Incidence rates

Key Points
- The overall estimated incidence of MU after OAGB was 2.59%.
- Approximately 65% of patients presented within the first 12 months after surgery.
- The majority of patients (89.7%) are treated conservatively with PPIs.

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Introduction

The Health Survey for England 2019 estimated that the proportion of the adult UK population living with obesity has risen from 14.9% in 1993 to 28.0% in 2019 [1]. This appears to be a global trend and bariatric surgery has emerged as an effective treatment [2]. Sleeve gastrectomy and Roux-en-Y gastric bypass (RYGB) are the two commonest bariatric procedures worldwide [2, 3]. One-anastomosis gastric bypass (OAGB), introduced by Rutledge in 1997, has recently gained popularity and is currently the third commonest bariatric procedure worldwide [4, 5]. It is suggested to have a technically less demanding learning curve whilst offering comparable benefits to RYGB [5, 6].

Bariatric procedures are currently advocated as the recommended treatment for severe obesity, as they

achieve better outcomes when compared to conservative treatment [6, 7]. Despite this, patients have identified risks of surgery and complications as barriers to opting for surgical treatment [8]. It is, therefore, important to understand them better.

Marginal ulceration (MU) at the anastomosis between the gastric pouch and the small intestine is a recognised complication of gastric bypass procedures. Though some studies have suggested that the risk of MU is higher with OAGB compared to RYGB [4, 9–11], there is no robust data on the MU after OAGB in scientific literature. In particular, there is currently no published systematic review focussing on MU following OAGB. The purpose of this systematic review was to understand the incidence, risk factors, and management of MU following OAGB.

Methods

This systematic review was performed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [12]. A systematic review protocol was prospectively registered on PROSPERO (CRD42022362594). The primary outcome of this study was to identify the incidence rate of MU following OAGB. The secondary outcomes included understanding its risk factors, investigation, and management of MU.

Literature Search Strategy

Databases including MEDLINE, Scopus, and Cochrane Library were used to systematically identify all studies on OAGB where authors had reported on MU. The search was conducted from inception until the 21st of September 2022. The following Medical Subject Headings were used: "Mason's loop", "mini-gastric bypass", "mini-gastric bypass", "single anastomosis gastric bypass", "single-anastomosis gastric bypass", "single anastomosis (mini-) gastric bypass", "one anastomosis (mini-) gastric bypass", "one anastomosis gastric bypass", "one-anastomosis gastric bypass", "omega gastric bypass", "omega-loop bypass", "omega loop bypass" AND "Peptic ulcer disease", "marginal ulceration", "marginal ulcer", "anastomotic ulcer", "ischemic ulcer", "ulcers" (Appendix).

Inclusion and Exclusion Criteria

We included patients of all ages who underwent an OAGB for obesity. This review includes randomised controlled trials, non-randomised controlled trials, and observational studies. Only English-language articles were included. We excluded case reports, ongoing trials, and studies on revisional OAGB surgeries.

Study Selection

Titles and/or abstracts of studies obtained from our search were screened independently by two reviewers (S.L. and S.S.). Ninety-four studies were obtained in full text and independently reviewed for eligibility by both reviewers (S.L. and S.S.). Any discrepancies were resolved by discussion with a third reviewer (K.M.).

Data Extraction

A total of thirty-two articles were included in our systematic review. Two authors (S.L. and S.S.) reviewed all eligible studies independently and extracted data using a standardised Microsoft Excel worksheet. The following data were included: author; year of publication; inclusion period; study design; the number of participants; participants' characteristics; mean age; mean body mass index; associated risk factors; surgical techniques; postoperative complications; investigation and treatment of MU. Any discrepancies were then discussed among the two reviewers (S.L. and S.S.) and if required the third reviewer (K.M.).

Quality of Assessment

Two reviewers (S.L. and S.S.) independently assessed the risk of bias in the included studies using the Jadad scoring system for randomised control trials [13] and the Newcastle-Ottawa Scale (NOS) for non-randomised controlled trials [14].

Statistics

All statistical analyses were conducted in R version 4.0.3 [15], using the *meta* package [16]. Funnel plots were visually inspected to assess publication bias. The pooled incidence of MU was calculated using the generic inverse variance method after log transformation. Where cohorts from multiple studies overlapped in time and institution, only the largest cohort was included in the meta-analysis. Pooled estimates used the DerSimonian-Laird estimator for between-study variance and are reported with associated 95% confidence intervals (CIs) [17]. A random effects model was chosen owing to the expected heterogeneity between studies.

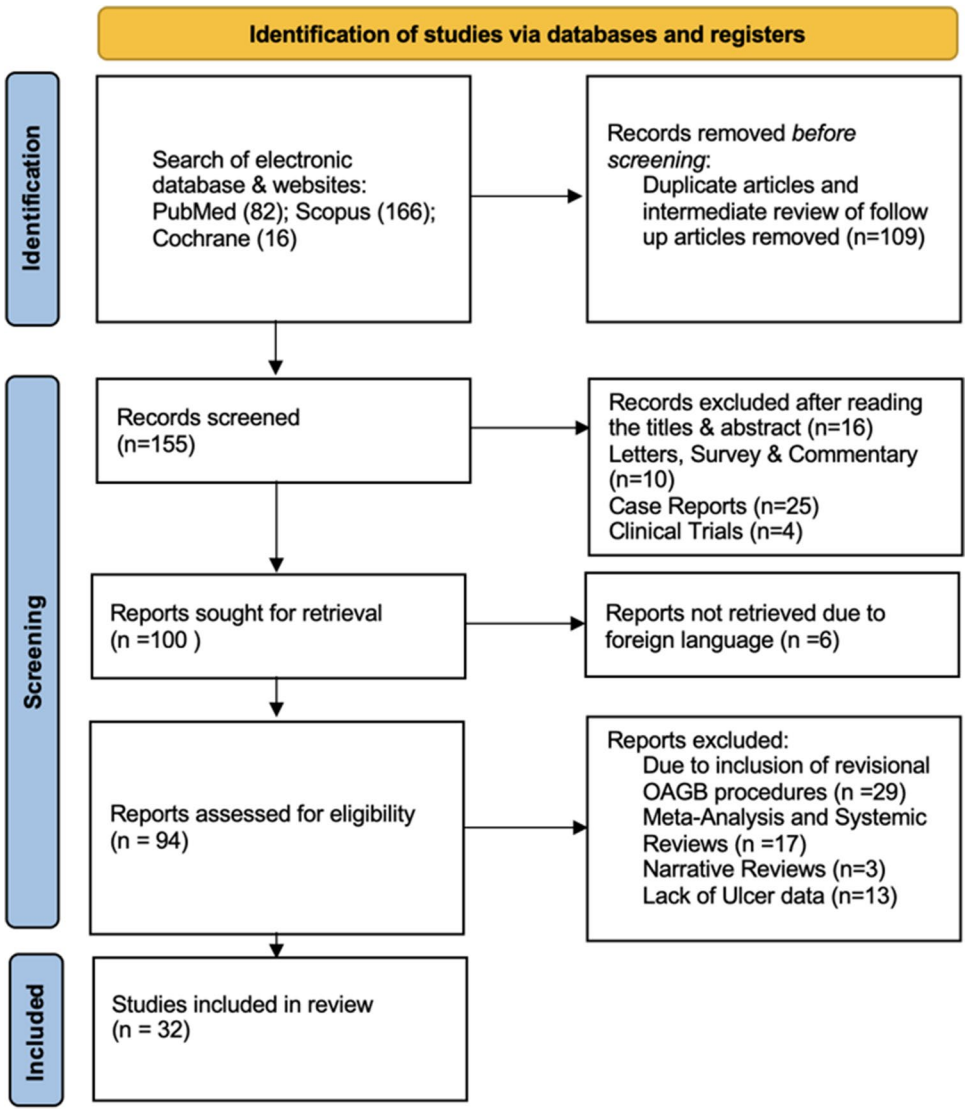

Fig. 1 PRISMA flowchart for studies retrieved through the searching and selection processes

Results

Study Characteristics

A total of thirty-two articles were included in our systematic review. Figure 1 outlines the PRISMA flowchart. Our initial search resulted in 264 articles. After removing duplicates, thorough screening, and full-text assessment, 32 articles were included in our study. These articles comprised nine prospective cohort studies, 19 retrospective cohort studies, and three randomised controlled trials. A total of 8868 patients met the inclusion criteria and were included for data analysis. A summary of study characteristics is outlined in Table 1.

Patient Demographics and Comorbidities of the Baseline Population

The mean age and preoperative body mass index (BMI) were 40.9 ± 4.5 years and 47.6 ± 5.6 kg/m^2, respectively. Among the patient cohort, approximately 72% were females (6388/8868); 20.6% (1825/8868) had preoperative gastroesophageal reflux disease; 46.3% (4105/8868) were treated for preoperative hypertension; and 30.3% (2690/8868) were diagnosed with type 2 diabetes mellitus. Basic patient demographics and comorbidities are summarised in Table 2.

Table 1 Study characteristics

Author	Year	Country	Patients (*N*)	Inclusion period	Study design
Miller et al	2020	Austria	12	October 2013–February 2014	Prospective
Kular et al	2014	India	1054	February 2007–January 2013	Retrospective of prospectively collected database
Jammu et al	2015	India	473	January 2007–March 2014	Prospective
Slagter et al	2021	Netherlands	703	January 2015–December 2016	Retrospective
Saarinen et al	2019	Finland	40	November 2016–December 2018	Randomised controlled trial
Sumer et al	2021	Turkey	44	September 2018–January 2020	Retrospective of prospectively collected database
Schmitz et al	2021	Germany	150	2008–2020	Retrospective
Elkerkary et al	2021	Egypt	20	June 2018–September 2020	Prospective
Tasdighi et al	2021	Iran	209	March 2013–2017	Retrospective of prospectively collected database
Markopoulos et al	2022	Greece	34	June 1994–September 2018	Retrospective of prospectively collected database
Bhandari et al	2019	India	90	2012	Retrospective of prospectively collected database
Rutledge et al	2005	USA	2410	September 1997–February 2004	Prospective
Szymanski et al	2021	Poland	50	1 January 2016–December 2017	Retrospective of prospectively collected database
Liagre et al	2021	Italy, France	245	May 2010–December 2017	Retrospective of prospectively collected database
Campanelli et al	2022	Italy	86	January 2018–October 2020	Prospective
Piazza et al	2011	Italy	197	July 1995–May 2011	Retrospective
Olmi et al	2019	Italy	50	January 2013–December 2018	Retrospective
Mustafa et al	2020	UK	198	January 2014–December 2016	Retrospective of prospectively collected database
Lee et al	2005	Taiwan	40	October 2001–March 2002	Randomised controlled trial
Kansou et al	2016	France	136	January 2010–July 2014	Retrospective
Shivakumar et al	2018	India	101	2013–2015	Randomised controlled trial
Noun et al	2007	Lebanon	126	October 2004–October 2006	Retrospective
Winstanley et al	2021	UK	89	October 2012–April 2018	Retrospective
Rheinwalt et al	2019	Germany	324	July 2010–May 2017	Prospective
El Abd et al	2021	Kuwait	40	January 2015–January 2018	Retrospective
Pizza et al	2020	Italy	241	July 2014–February 2019	Retrospective
Baksi et al	2020	India	68	January 2015–May 2019	Retrospective of prospectively collected database
Meydan et al	2016	Israel	106	June 2015–February 2016	Retrospective of prospectively collected database
Charalampos et al	2018	Greece	94	April 2009	Retrospective of prospectively collected database
Musella et al	2013	Italy	974	July 2006–December 2012	Retrospective
Pizza et al	2020	Italy	190	January 2016–January 2018	Randomised controlled trial
Mari et al	2020	Israel	274	2010–2018	Retrospective

Surgical Technique

OAGB was performed laparoscopically in all studies. The mean operative time was 90.6 ± 33.5 minutes. Various bilio-pancreatic limb (BPL) lengths were used, mostly measuring 200 cm ($n = 8$) [11, 18–24]. Some studies adjusted the BPL length according to BMI ($n = 3$) [25–27]. Four studies did not describe the BPL length used [28–31].

The size of the bougie used to create the gastric pouch was reported to be inconsistent. Most studies reported using 36 Fr ($n = 10$) [18, 23, 32–39] followed by 38 Fr ($n = 5$) [11, 20, 27, 29, 40], 34 Fr ($n = 2$) [41, 42], 30 Fr ($n = 2$) [26, 43], 39 Fr ($n = 1$) [25], 28 Fr ($n = 1$) [5], 28–36 Fr ($n = 1$) [21], 36–42 Fr ($n = 1$) [44], and 34 Fr or 36 Fr ($n = 1$) [45]. Eight studies did not specify the size of bougie used [19, 22, 24, 28, 30, 31, 46, 47].

Six studies described performing single-layer running sutures for stapler site closure [18, 25, 27, 36, 42, 45]. The length of the gastric pouch was only mentioned in a few studies (Table 3). Saarinen et al. described a fixed length of 15 cm for the gastric pouch [40], whereas others had varying lengths of gastric pouches: 16–22 cm [43], 12–18 cm ($n = 1$) [33], and 16–18 cm ($n = 1$) [44].

Postoperative Care

The average length of stay was 3.6 ± 1.0 days. Only 14.1% (1252/8868) of patients were documented to have been prescribed proton-pump inhibitors (PPI) after surgery with various duration reported: 1 month ($n = 44$) [25], 3 months ($n = 295$) [29, 34], 6 months ($n = 605$) [30, 31], 12 months ($n = 190$) [39], and unspecified ($n = 118$) [19, 24]. A small

Table 2 Patient demographics at baseline

Characteristics	Number of patients (%)
Overall	8868
Age (years)	40.9 ± 4.5
BMI (kg/m^2)	47.6 ± 5.6
Sex	
Male	2480
Female	6388 (72)
Patient comorbidities	
Preoperative GORD	1825 (20.6)
Reported current smokers	106 (2.3)
Hypertension	4105 (46.3)
OSA	2334 (26.3)
Dyslipidaemia	3294 (37.1)
Osteoarthritis	1502 (16.9)
T2DM	2690 (30.3)

GORD gastroesophageal reflux disease, *OSA* obstructive sleep apnoea, *T2DM* type 2 diabetes mellitus

minority of patients, 5.2% (463/8868), reported developing reflux symptoms after surgery.

Incidence of MU

The overall incidence of MU was 2.59% (95% CI 1.89–3.52) (Fig. 2). The incidence of MU was 2.89% (95% CI 1.96–4.23) in units across Europe compared to 1.70% (95% CI 0.67–4.25) in Asia (Fig. 3). The incidence of MU was 2.40% (95% CI 0.74–7.57) in units across the Middle East and North America (Fig. 3).

Clinical Presentation, Investigation, and Treatment for MU

Out of the 228 patients with MU, only 82 had their diagnosis timeline recorded. Of those, 65% were diagnosed within the first 12 months of surgery. Approximately 23.7% (54/228) were diagnosed with MU on endoscopy for the following symptoms: dyspepsia ($n = 8$) [19, 20], symptomatic reflux ($n = 38$) [41, 45], unspecified gastrointestinal symptoms ($n = 2$) [31], gastrointestinal bleed ($n = 2$) [39], and symptomatic anaemia ($n = 2$) [42]. In contrast, Saarinen et al. performed a routine endoscopy for patients 6 months after surgery, at which 10% (4/40) of patients were found to have MU [40]. Pizza et al. and Baksi et al. have also mentioned performing routine endoscopies for asymptomatic patients, which resulted in diagnosing three and four MU, respectively [11, 38]. Sumer et al. reported one patient returning to the emergency department 2 months after surgery with severe epigastric pain [25]. Fifteen studies did not specify how MU was diagnosed.

The treatment method was only available for 68.0% ($n = 156/228$) of the patients. Of these, 89.7% were treated conservatively with PPIs and 10.3% required surgery. Rutledge et al. reported three patients proceeding with revisional surgery due to failed medical treatment of MU [5]. Mustafa et al. described one patient requiring conversion to RYGB to treat perforated MU and another requiring revisional surgery due to stricture at GJ anastomosis secondary to chronic MU [47]. Shivakumar et al. described performing an omental patch repair in one patient with MU diagnosed 11 months after surgery [36]. Endoscopic haemostasis had to be carried out in one patient with bleeding MU [42]. Of patients, 31.6% (72/228) did not have specified treatment mentioned in the studies.

Risk of Bias

The average NOS score was 5.56. There was inadequate comparability of cohorts with a lack of adjustment for confounding. All three RCTs did not specify the total number and reason for withdrawals. Two RCTs were deemed low risk of bias [36, 39] (≥3/5), whilst one RCT did not report the method of randomisation nor blinding of participants in the published article [40]. The full assessment of the risk of bias for each study can be found in Table 4.

Discussion

To our knowledge, this is the first systematic review and meta-analysis on MU after OAGB. We have found an overall incidence rate of MU at 2.59% after OAGB. The median presentation time of MU following OAGB is within 12 months. PPI prophylaxis prescription was described to have been given to 14.1% of patients, with variable total duration reported. Of patients with MU, 89.7% were managed conservatively with PPIs. However, the course of treatment remains inconclusive.

PPI Prophylaxis

The duration of PPI prophylaxis after OAGB also remains inconclusive. A recent survey suggested variable duration of postoperative PPI prescription among surgeons: 20.2%, 43.6%, and 18.6% reported 1, 3, and 6 months respectively [48]. Ying et al. suggested 1 year of PPI prophylaxis due to the low incidence of MU reported following RYGB [49]. Our review has shown that the majority of MU (63%) presented within the first 12 months following OAGB. In light of these findings, PPI for MU prophylaxis should be recommended for at least a year following OAGB, if not longer. It is the authors' current practice to recommend

Table 3 Summary of studies included in this analysis

Author	Patients (*N*)	Marginal ulcers (%)	Total follow-up (months)	Follow-up (%)
Miller et al	12	0	60	100
Kular et al	1054	5 (0.47)	72	84
Jammu et al	473	3 (0.63)	87	52
Slagter et al	703	24 (3.4)	44	Not specified
Saarinen et al	40	4 (10)	6	95
Sumer et al	44	1 (2.27)	26	75
Schmitz et al	150	11 (7.33)	24	At 12 months, 65. At 24 months, 45
Elkerkary et al	20	5 (25)	12	100
Tasdighi et al	209	2 (0.96)	36	At 12 months, 87.1. At 24 months, 77.1. At 36 months, 61.6
Markopoulos et al	34	0	72	At 72 months, 52.9
Bhandari et al	90	3 (3.33)	60	63.3
Rutledge et al	2410	97 (4.02)	74.4	68
Szymanski et al	50	0	28	100
Liagre et al	245	3 (1.22)	80	At 12 months, 87.7. At 24 months, 75.1. At 60 months, 32.2. At 72 months, 17.5. At 80 months, 5.7
Campanelli et al	86	0	36	92.3
Piazza et al	197	3 (1.52)	36	96
Olmi et al	50	0	24	Not specified
Mustafa et al	198	10 (5.10)	24	100
Lee et al	40	1 (2.5)	24	100
Kansou et al	136	10 (7.35)	12	88.4
Shivakumar et al	101	2 (1.98)	36	At 12 months, 100. At 24 months, 96. At 36 months, 92.1
Noun et al	126	3 (2.38)	27	87
Winstanley et al	89	4 (4.49)	28	100
Rheinwalt et al	324	10 (3.10)	36	At 12 months, 79.15. At 24 months, 64.56. At 36 months, 50
El Abd et al	40	0	31	100
Pizza et al	241	3 (1.24)	52	75.1
Baksi et al	68	4 (5.88)	12	73.7
Meydan et al	106	2 (1.89)	6	At 1 month, 98. At 3 months, 82. At 6 months, 79
Charalampos et al	94	1 (1.06)	12	81.7
Musella et al	974	14 (1.44)	12	94.8
Pizza et al	190	1 (0.53)	12	35.8
Mari et al	274	2 (0.73)	3	Not specified

PPI prophylaxis for 5 years after both types of gastric bypass procedures after obesity [50].

Diagnosis

In 2020, the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) committee published guidelines on the timing of routine endoscopy after OAGB. Routine endoscopy has been suggested for patients at year 1 and years 2 to 3 following OAGB to minimise the risk of undiagnosed upper gastrointestinal or Barrett's oesophagus malignancies [51].

Management of MU

The review of included studies revealed significant variations in the management of MU. Jammu et al. suggested intravenous antibiotics (cefotaxime, tinidazole) and PPI for 5 days, followed by oral PPI for 6 months [20]. Baksi et al. reported a similar treatment consisting of oral PPI and sucralfate for 2 months [11]. On the contrary, Piazza et al. treated three patients with MU with 4–5 days of intravenous PPI. Regardless, most patients were successfully managed conservatively and only a small proportion of patients, 10.3%, needed revisional surgeries [5, 32–34, 36, 38, 42, 45, 47].

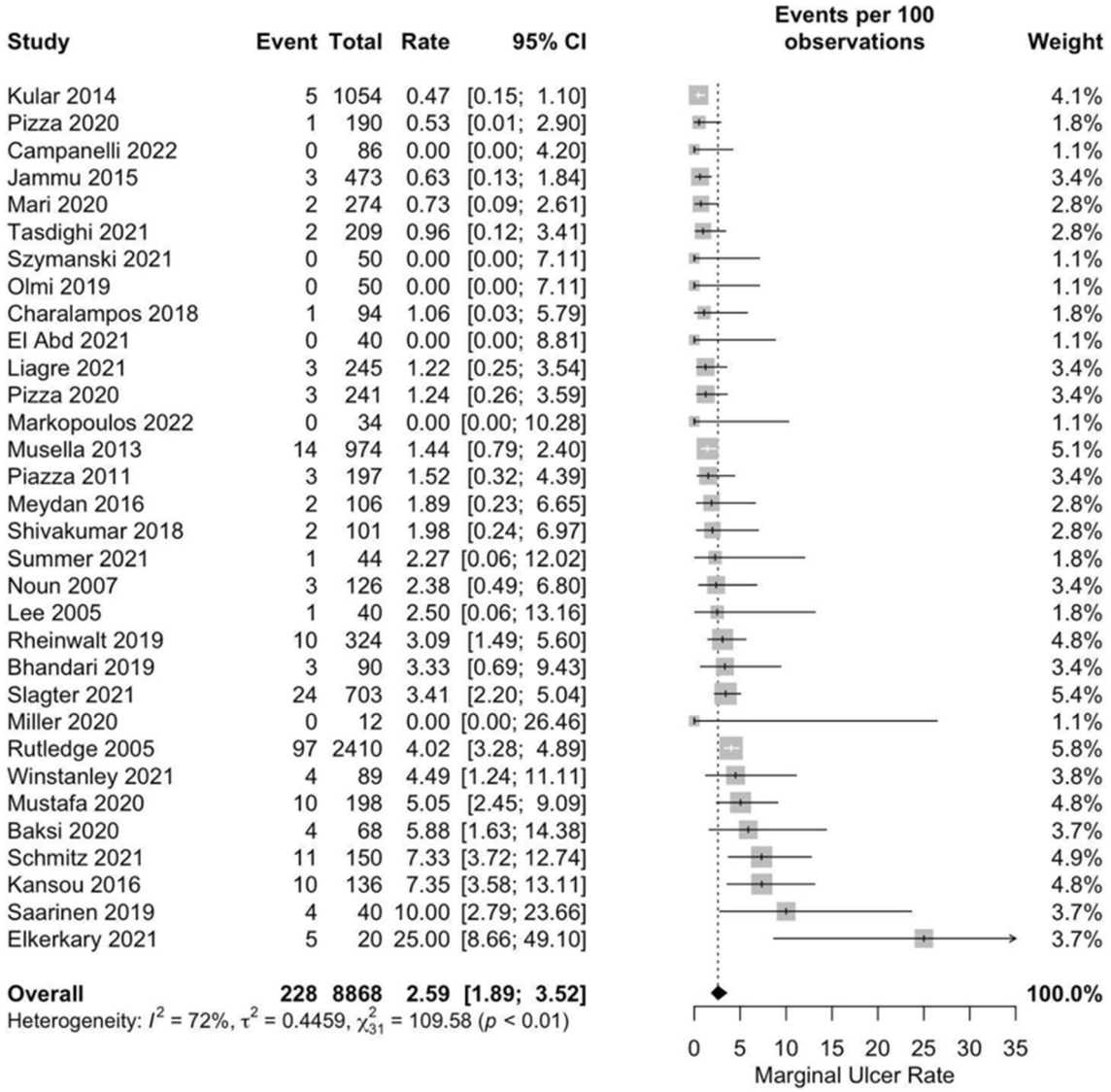

Fig. 2 Overall incidence of marginal ulcers following OAGB

Risk Factors

We did not observe any consistent association between the BPL length and the incidence of MU. Bertrand et al. conducted a retrospective cohort study and reported a significantly lower rate of MU in patients who had undergone OAGB with BPL length of 150 cm compared to 200 cm (OR = 0.4) [52]. Liagre et al. reported a MU rate of 1.22% (3/245) in OAGB with BPL length of 150 cm [34]. With a similar BPL length of 150 cm, Mustafa et al. concluded that 5% (10/198) of MU occurred in patients following OAGB [47]. In contrast, ElAbd et al. did not report any MU in a retrospective cohort study consisting of 40 patients undergoing OAGB with BPL length of 150cm [37]. Schmitz et al. reported a MU rate of 7.3% (11/150) with a BPL length of 250 cm [43]. On the other hand, Markopoulos et al. reported no MU in 36 patients undergoing OAGB with a BPL length of 250 cm [46].

There is currently limited data on the causative factors of MU following OAGB. Chevallier et al. reported a 10% (2/20) rate of MU following OAGB, and both participants were smokers [53]. Similarly, Pizza et al. concluded a 1.2% (3/241) rate of MU following OAGB in which all three participants were heavy smokers and consumed alcohol at least three times a week. All three patients needed conversion to RYGB [38]. Sumer et al. reported a 2.3% (1/44) rate of MU, occurring in one patient who was a heavy smoker [25]. Winstanley et al. reported a 4.5% rate of MU following OAGB in patients with hiatal hernia [30].

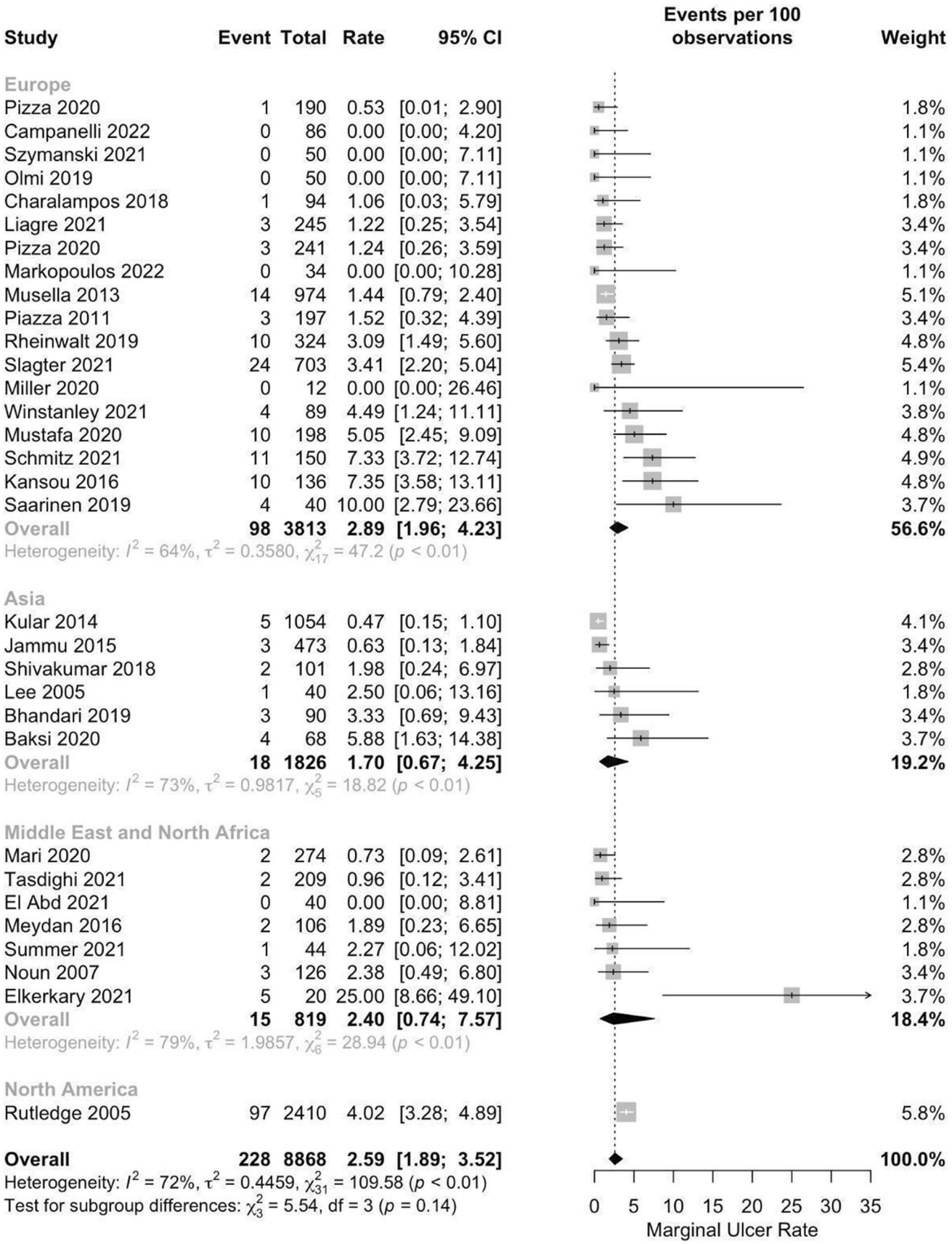

Fig. 3 Incidence of MU and subgroup analysis by country

Table 4 Summary of risk of bias assessment

Author	Repre-sentative-ness	Selection	Ascertain-ment	Demonstra-tion (outcome not present at start)	Comparability	Assessment of outcome	Length of follow-up	Adequacy of follow-up	NOS score	Randomisa-tion	Blinding	Withdrawals	JADAD score
Miller	0	1	1	1	0	1	1	1	6				
Kular	1	1	1	1	0	1	1	1	7				
Jammu	1	1	1	1	0	1	1	0	6				
Slagter	1	1	1	1	1	1	1	0	7				
Saarinen										0	0	0	0
Sumer	1	1	1	1	0	1	1	1	7				
Schmitz	0	1	1	1	0	1	1	0	5				
Elkerkary	0	1	1	1	0	1	0	1	5				
Tasdighi	1	1	1	0	0	1	1	0	5				
Markopoulos	1	1	1	1	0	1	1	1	7				
Bhandari	1	1	1	1	0	1	1	0	6				
Rutledge	1	1	1	1	0	1	1	0	6				
Szymanski	1	1	1	1	0	1	1	1	7				
Liagre	1	1	1	1	0	1	1	0	6				
Campanelli	1	1	1	1	0	1	1	1	7				
Piazza	1	1	1	1	0	1	1	1	7				
Olmi	1	1	1	1	1	1	1	0	7				
Mustafa	1	1	1	1	0	1	1	1	7				
Lee										2	0	0	2
Kansou	1	1	1	1	0	1	1	1	7				
Shivakumar										2	1	0	3
Noun	1	1	1	1	0	1	1	1	7				
Winstanley	0	1	1	1	0	1	1	1	6				
Rheinwalt	1	1	1	1	0	1	1	0	6				
El Abd	1	1	1	1	0	1	1	1	7				
Pizza	1	1	1	1	0	1	1	1	7				
Baksi	1	1	1	1	0	1	1	1	7				
Meydan	1	1	1	1	0	1	0	1	6				
Charalampos	1	1	1	1	0	1	1	0	6				
Musella	1	1	1	1	0	1	1	1	7				
Pizza										2	2	0	4
Mari	0	1	1	1	0	1	0	0	4				

A long, narrow gastric pouch has been recommended to counteract acid build-up at the anastomosis site, which could lead to an increased risk of MU [53]. Wilson et al. conducted a retrospective study of 1001 participants and subsequently reported that both smoking (aOR = 30.6) and the use of non-steroidal anti-inflammatory drugs (NSAIDs) (aOR = 11.5) contributed to the formation of MU following RYGB [54]. Beran et al. recently published a systematic review and meta-analysis which suggested the following risk factors of MU in patients who have had RYGB: helicobacter pylori (HP) infection (OR 4.97 [2.24–10.99]), smoking (OR 2.50 [1.76–3.54]), and diabetes mellitus (OR 1.80 [1.15–2.80]) [55]. Bhayani et al. concluded that preoperative hypertension is a significant predictive factor of MU in patients undergoing RYGB [56].

Limitations and Strengths

Our study has several limitations. Firstly, we have found that most studies did not routinely report risk factors that may contribute to MU. There were only three studies with reported data on smoking. Therefore, we could not establish any causative links between potential risk factors and MU. Instead, we reported results from studies included separately and compared them accordingly. As a result, there has been a lack of multivariable analyses resulting in difficulties when comparing results in most studies and, thus, confounding bias. Secondly, our review consisted mainly of retrospective studies. As a result, there were gaps in data reporting, including unspecified timings of endoscopy performed when diagnosing MU. Thus, it was difficult to determine the exact presentation time of marginal ulcers in each study. In addition, endoscopic findings and morbidity and mortality rates were not routinely reported. Moreover, there was no standardised description of the routine practice of gastroenterologists when encountering MU in the current literature. Hence, there seemed to be a lack of clarification on whether MUs managed by gastroenterologists were routinely reported to the surgical team resulting in a potential risk of underreporting of incidence of MU.

Our study is the first to have succinctly summarised current literature on MU, and we hope our findings will guide clinicians in decision-making when treating this condition.

Conclusion

Our study concluded an estimated overall incidence of MU at 2.59% (95% CI 1.89–3.52); the risk of underreporting remains. The majority of MU can be treated conservatively with PPI. Future studies on risk factors, clinical presentation, investigation, and treatment of MU are recommended.

Appendix
Search strategy

Ovid MEDLINE(R) ALL <1946 to August 10, 2022>

1	exp *Peptic Ulcer/	61,705
2	(marginal ulcer or marginal ulceration or marginal ulcers).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	490
3	stomal ulceration.mp.	39
4	(stomal ulcers or stomal ulcer).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	156
5	2 or 3 or 4	671
6	(gastric adj bypass).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	16,341

7	(bariatric adj bypass).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	26
8	exp *Gastric Bypass/	9793
9	6 or 7 or 8	16,354
10	5 and 9	308
11	10	308
12	limit 11 to (English language and humans and yr="2015–Current")	128
13	proton pump inhibitor.mp. or exp *Proton Pump Inhibitors/	17,160
14	proton pump inhibitors.mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	17,792
15	13 or 14	24,634
16	9 and 15	149
17	prophylaxis.mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	12,0005
18	prophylactic.mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	87,767
19	17 or 18	19,1174
20	16 and 19	17
21	10	308
22	limit 21 to (human and English language and exclude medline journals and yr="2019–Current")	65
23	20 not 10	4
24	23	4
25	limit 24 to (English language and exclude medline journals)	4
26	incidence.mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	97,3337
27	9 and 26	1487
28	(ulcer or ulcers or ulceration).mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	21,0204
29	27 and 28	137
30	29 not 10	45
31	30	45
32	limit 31 to (English language and humans and yr="2019–Current")	6
33	9 and 15 and 19 and 28	15
34	33 not 30	15
35	33 not 20	0

Scopus

"mason's loop" OR "mini-gastric bypass" OR "mini-gastric bypass" OR "single anastomosis gastric bypass" OR "single-anastomosis gastric bypass" OR "single anastomosis (mini-) gastric bypass" OR "one anastomosis (mini-) gastric bypass" OR "one anastomosis gastric bypass" OR "one-anastomosis gastric bypass" OR "omega gastric bypass" OR "omega-loop bypass" OR "omega loop bypass" AND "Peptic ulcer disease" OR "marginal ulceration" OR "anastomotic ulcer" OR "ischemic ulcer" OR "ulcers" OR "ulcera*"

Cochrane

mason's loop OR mini-gastric bypass OR mini-gastric bypass OR single anastomosis gastric bypass OR single-anastomosis gastric bypass OR single anastomosis (mini-) gastric bypass OR one anastomosis (mini-) gastric bypass OR one anastomosis gastric bypass OR one-anastomosis gastric bypass OR omega gastric bypass OR omega-loop bypass OR omega loop bypass in Title Abstract Keyword AND Peptic ulcer disease OR marginal ulceration OR anastomotic ulcer OR ischemic ulcer OR ulcers OR ulcera* in Title Abstract Keyword

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Author Contribution Study conceptualisation: K.M., S.L., S.S.
Data analysis: S.L., C.V.
Writing the manuscript and approving the finalised manuscript: S.L., S.S., C.V., K.M.

Declarations

Ethical Approval Formal consent is not required for this type of study.

Conflict of Interest The authors declare no competing interests.

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