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Challenging the knot: a review of barbed sutures in gastrointestinal surgery

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ABSTRACT

Introduction: Despite advances in laparoscopic techniques, intracorporeal suturing remains laborious and technically demanding. Barbed sutures have been introduced as a potential solution, but their role is still being evaluated. *Methods:* We conducted a literature search using PubMed, Scopus, and Google Scholar to identify studies using knotless sutures in gastrointestinal surgery. *Results:* Fourteen studies met the inclusion criteria. Most of the included studies focused on bariatric and colorectal procedures. In bariatric procedures, barbed sutures significantly reduced operative time. The safety of barbed sutures was comparable to traditional sutures, with no notable increase in leaks, bleeding, or strictures. Findings on the use of barbed sutures in colorectal surgery were mixed. Some studies reported time savings with knotless sutures, while others found no significant difference. Safety outcomes were similar between barbed and conventional sutures. *Conclusions:* Barbed sutures shortened operation times without increasing postoperative complications when used in bariatric procedures. The effectiveness of barbed sutures in colorectal surgery remains unclear. Although promising, using knotless sutures in minimally invasive surgery requires further research to evaluate long-term outcomes and refine surgical techniques.

Keywords: barbed sutures, bariatric surgery, colorectal surgery

1. INTRODUCTION

Minimally invasive techniques have transformed gastrointestinal surgery over the last few decades, offering patients quicker recoveries and shorter hospitalizations than traditional open procedures (Milone et al., 2018). However, laparoscopic procedures come with their own set of technical challenges — particularly intracorporeal suturing and knot tying, which many surgeons consider among the most challenging skills to master (Deziel et al., 1993). The intricacy of these tasks often prolongs operative time and may increase the risk of

postoperative complications, such as bleeding, anastomotic leak, or stenosis (Ritter et al., 2005).

Barbed sutures differ from conventional types by using barbs to hold tissue without knots — a feature that can simplify suturing. Though their use is expanding, surgeons continue to debate their safety, particularly in relation to complications. Multiple studies have found barbed sutures helpful in gynecology, urology, and plastic surgery (de Blacam et al., 2012; Savasta et al., 2024; Shah et al., 2012a). However, there is still little evidence regarding the usage of barbed sutures in gastrointestinal surgery.

This review examines existing evidence on the safety and effectiveness of barbed sutures in gastrointestinal surgery and compares their clinical performance with traditional suturing techniques.

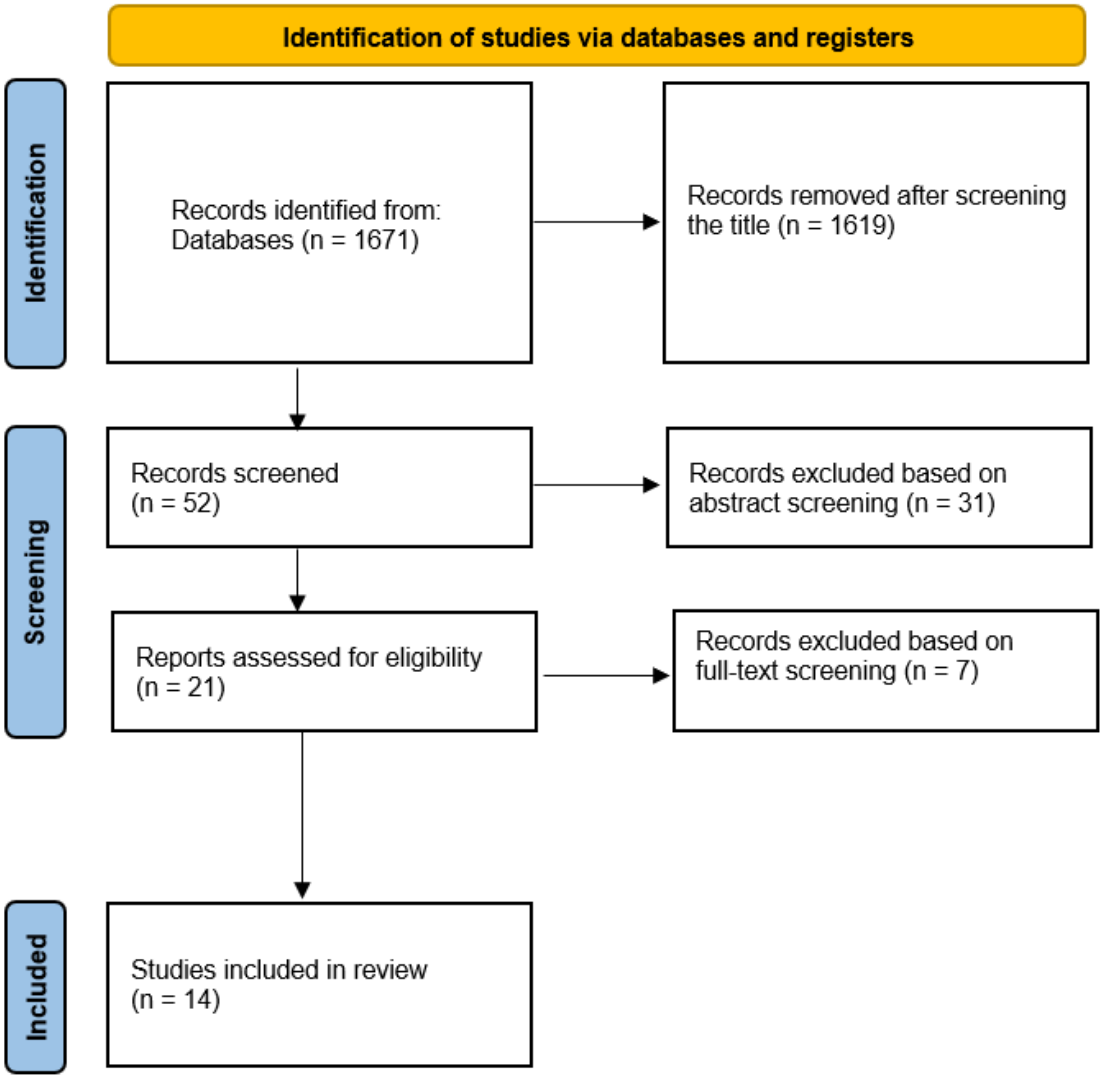

Figure 1. PRISMA flow diagram

2.MATERIALS AND METHODS

We performed a thorough literature search across PubMed, Scopus, and Google Scholar to assemble relevant data. Eligible studies had to compare barbed sutures with conventional ones and include safety outcomes. Case reports, reviews, editorials, and studies on non-gastrointestinal procedures were excluded. The search strategy included terms related to "barbed sutures," "gastrointestinal surgery," and "safety." Boolean operators (OR and AND) were used to improve search results. Only articles published in English between January 2010 and November 2024 were included. Two independent researchers conducted the article identification process. After an initial assessment of all potentially relevant articles by reviewing titles and abstracts, studies unrelated to the research topic, case reports, review articles, and meta-analyses were excluded. The article selection process adhered to the PRISMA guidelines (Fig.1).

3. RESULTS & DISCUSSION

The search strategy identified a total of 1671 articles. Primary title selection excluded 1619 articles. After screening the abstract, 21 articles were selected. After a full-text analysis, 14 articles were selected. The included studies involved 27584 patients, 3577 cases (patients who underwent barbed sutures usage), and 24007 controls (patients who underwent conventional sutures or stapler closure). Table 1 summarizes the characteristics of the included studies. Of the 14, nine examined barbed versus conventional sutures in bariatric surgery, four focused on colorectal procedures, and one addressed their use in peptic ulcer repair.

Table 1. Characteristics of included studies

Study	*Type of of surgery*	*Type of closure technique*	*Patients (n.)*	*Age (years)*	*Operative time (min)*	*Leak (n.)*	*Stenosis (n.)*	*Bleeding (n.)*
Pennestrì et al., 2023	RYGB for obesity	Barbed	161	45	65	0	1	2
		Conventional	161	43	95	1	0	1
Xu et al., 2022	Left colectomy	Barbed	41	61,7	-	5	0	0
		Conventional	82	61	-	6	0	1
Milone et al., 2020	Right colectomy	Barbed	245	68,09	-	2	-	1
		Conventional	210	68,48	-	5	-	8
Bures et al., 2019	RYGB for obesity	Barbed	45	43,7	123,2	0	1	0
		Conventional	45	45,4	127,5	0	0	0
Pennestrì et al., 2019	RYGB + MGB/OAGB	Barbed	268	44,09	66,4	1	2	3
		Conventional	268	41,8	87,8	3	1	3
Bracale et al., 2018	Right colectomy	Barbed	40	72,5	120,9	1	0	-
		Conventional	40	74,5	134,9	1	0	-
Kim et al., 2018	Peptic ulcer repair	Barbed	54	57,4	87,7	0	1	-
		Conventional	65	60,8	131,2	2	3	-
Feroci et al., 2018	Right colectomy	Barbed	47	72,5	120	1	-	-
		Conventional	47	69	127,5	1	-	-
Vidarsson et al., 2017	RYGB for obesity	Barbed	2211	41	58	39	2	-
		Conventional	22795	40,9	69	319	32	-
Gys et al., 2017	RYGB for obesity	Barbed	100	40,4	60	1	-	0
		Conventional	100	38,9	61	0	-	4
Milone et al., 2013	MGB/OAGB	Barbed	30	36,5	122,7	1	0	0
		Conventional	30	35,1	134,4	1	0	1
Costantino et al., 2013	RYGB for obesity	Barbed	239	38	62,7	0	3	1
		Conventional	76	40	74,3	0	1	0
Tyner et al., 2013	RYGB for obesity	Barbed	46	48,3	154,2	0	1	1
		Conventional	38	46,3	178,9	0	0	1
De Blasi et al., 2013	RYGB for obesity	Barbed	50	43,7	119,2	0	0	-
		Conventional	50	42,4	125	0	0	-

RYGB: Roux-en-Y Gastric Bypass; MGB/OAGB: Mini Gastric Bypass/One Anastomosis Gastric Bypass.

Bariatric surgery

The majority of included studies focused on bariatric procedures. Several studies document significant time savings with barbed suture use. An extensive registry analysis of over 25,000 gastric bypass cases found that using barbed sutures shortened the total operative time by about 16% (58 min vs. 69 min, $p < 0,001$) (Vidarsson et al., 2017). Some single-center series report dramatic time differences; a propensity-matched study observed approximately 31% reduction in operation time when barbed sutures were used for the gastro-jejunal anastomosis (65 min vs 95 min, $p < 0,001$) (Pennestrì et al., 2023). Gys et al., (2017) reported that, in a randomized trial focusing on gastrojejunostomy closure, barbed sutures significantly sped up the anastomosis closure itself (7:41 min vs 8:13 min, $p = 0,005$) and required fewer extra stitches to complete the defect ($p = 0,027$). However, the study's authors did not find a statistically important difference in total operative time ($p = 0,340$).

Barbed sutures demonstrated a safety profile consistent with conventional sutures, with no significant increase in major complications. Extensive comparative studies reinforce these findings: Vidarsson et al., (2017), an extensive registry analysis found leak

or intra-abdominal abscess rates not differing statistically between knotless sutures and standard sutures. The same study reported anastomotic stricture occurrences under 0.2% in both groups, with no meaningful difference in stenosis frequency. Evidence shows that barbed sutures may help reduce the risk of specific complications. For example, Gys et al., (2017) found fewer postoperative bleeding events at the anastomosis in the knotless suture group than in the conventional group (n = 0 vs. n = 4, p = 0,043). Similarly, some of the matched studies reported no anastomotic leaks in patients who received barbed sutures, suggesting the technique may promote favorable outcomes (Pennestrì et al., 2019). Current evidence indicates that barbed sutures do not increase the risk of complications like bleeding, anastomotic leaks, or strictures. This supports their safe use in bariatric surgery without compromising healing at the anastomosis.

Colorectal surgery

Barbed sutures have also been used in colorectal procedures, though the results have not been as consistent as in bariatric surgery. Some studies have shown that knotless sutures can shorten operating time, while others have found no apparent benefit. Bracale et al., (2018) reported a noticeable reduction in operative time when barbed sutures were used for enterotomy closure. The mean surgery duration was 120,92 minutes with barbed closure vs. 134,92 minutes with conventional sutures, a significant 14-minute reduction (p = 0,035). However, Feroci et al., (2018) found no statistically significant difference in median operating time between barbed vs. traditional suture groups (120 min vs. 127.5 min, p = 0,761).

Milone et al., (2020) as well as Xu et al., (2022) did not report operative time. However, the latter found that completing the anastomosis using barbed sutures required a shorter time than in the stapler group (7,8 min vs 11,9 min, p < 0,001). This finding is consistent with the anastomotic time reported by Bracale et al., (2018), which showed a reduction in anastomotic time in the barbed sutures group in comparison to the conventional suture (12,1 min vs. 17,5 min, p < 0,05).

The safety profile of barbed sutures in colorectal surgery appears comparable to conventional sutures, with most research showing no increase in significant complications. All analyzed studies indicate that barbed sutures do not increase anastomotic leak rates. Feroci et al., (2018) reported one anastomotic leak in the barbed and traditional suture groups with no statistical difference. Similarly, Bracale et al., (2018) observed one leak in both the barbed and conventional suture groups. Xu et al., (2022) found a slightly higher leak rate with barbed hand-sewn anastomosis than stapled anastomosis, yet no statistically significant (12.2% vs. 7.3%, p = 0,439). Milone et al.'s (2020) extensive multicenter study found a lower leak incidence when a barbed suture was used for enterotomy closure (p = 0.001), suggesting knotless sutures may even help reduce leaks in some settings. Interestingly, the authors documented significantly fewer intraoperative/postoperative bleeding complications with barbed sutures than with smooth ones (p = 0.001). However, other studies did not report increased or reduced bleeding episodes with barbed anastomoses. None of the analyzed studies reported any anastomotic strictures associated with barbed suture use. The rates of anastomotic narrowing were effectively zero in both barbed and control groups across trials.

Minimally invasive surgery has transformed the way gastrointestinal procedures are performed, offering patients quicker recovery, reduction of pain, and fewer complications compared to traditional open techniques (Milone et al., 2018). However, the limited instrument maneuverability and restricted visibility make intracorporeal suturing one of the most demanding skills and a technical challenge. The answer to this challenge may be the development of barbed sutures designed to facilitate suturing by eliminating the need for knots. Barbed sutures were introduced in 1951 for tendon repairs (Nambi Gowri & King, 2023). Since then, surgeons have used knotless sutures in multiple laparoscopic and robot-assisted procedures, including colorectal and bariatric surgery (Shah et al., 2012b; Takayama, 2012). Studies have shown that barbed sutures reduce suturing time and, in many cases, total operative time, facilitating faster anastomotic closure without compromising quality (Gys et al., 2017; Pennestrì et al., 2019). That said, these findings may not apply across all surgical specialties. In bariatric surgery, barbed sutures provide more apparent benefits, although the results in colorectal surgery are very heterogeneous (Feroci et al., 2018; Vidarsson et al., 2017).

4. CONCLUSION

Barbed sutures have emerged as a helpful option in minimally invasive surgery, offering potential time savings without compromising patient safety. Their use is growing in both bariatric and colorectal procedures, with early studies from multiple centers reporting encouraging clinical outcomes. However, their long-term effectiveness, particularly in complex cases, remains uncertain due to limited high-quality research.

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Conflict of interest
The authors declare that there is no conflict of interests.

Data and materials availability
All data sets collected during this study are available upon reasonable request from the corresponding author.

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