Omega Suture for a Single Staple Line Rectal Anastomosis after Sigmoid Resection; a Controlled Prospective Pilot Study

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Introduction: In cases of stapled colorectal and ileorectal anastomosis employing surgical staplers, the "dog-ears" caused by the intersection of staple lines are thought to be the location of anastomotic leak ; hence, the importance of their excision.

Aim of work: Reevaluating the omega suture technique to resect the rectal staple line, along with those "dog-ears", within the circular stapler's distal doughnut is the goal of the study.

Patients and methods: For the proposed technique of applying omega suture prior to firing the circular stapler, thirty (30) patients with a variety of indications for sigmoid resection were recruited. Their data within a month postoperatively were compared to those of thirty "correlated" patients in our database.

Results: The study group saw a lower incidence of anastomotic leak, and the two groups' post-operative courses were similar.

Conclusion: For improved rectal anastomosis, it is recommended to add an omega stitch to the distal (Rectal) staple line before the circular stapler's last firing.

Key words: Rectal anastomosis, staple line dog-ears, omega stitch, stapled anastomosis, sigmoid resection.

Introduction

Despite the still ongoing research and abundant literature, the incidence of leak following rectal anastomosis is still high; 5.6-36%.[1,2]

It is well known that leaks are more common in rectal than colonic anastomosis.[3]

Defining anastomotic leak is a matter of debate.[4]

However, it is established that surgical technique plays an important role.[5]

The issue of staple line "dog-ears" became evident with the widespread use of stapled colorectal and ileorectal anastomosis utilizing the "double stapling" technique (DST), as explained by Knight and Griffen.[6-8]

Anastomotic leak is believed to be mostly caused by those dog ears.[7,9,10]

As a result, additional methods were put forth for their removal, such as the method of executing an omega suture prior to firing the circular stapler, which, according to Asao et al., turns the whole situation into a "single staple line".[11,12]

Aim of work: The aim of our study is to evaluate the feasibility and outcome of applying the "omega stitch" technique for open rectal stapled anastomosis, as regards operative time, incidence of early (Within one month follow up period) anastomotic leak and bowel function in various cases requiring sigmoid colon resection.

Patients and methods

After obtaining the approval of the ethical committee of our institute, thirty (30) cases presenting for elective sigmoid colon resection and primary anastomosis were recruited for our study. Patients presenting for emergent sigmoid colon resection were excluded except for those, with iatrogenic injury during colonoscopy discovered immediately during the procedure (Adequate bowel preparation). Only patients ASA I and II were included. Patients with previous laparotomy or concomitant rectal lesions, were excluded.

We decided to exclude patients with BMI above 35 (A risk factor for stoma retraction and hence postoperative peritonitis). The patients' sociodemographic information was documented. The patient (or first-degree relatives if not available) gave the required consent and preoperative tests, including CBC, coagulation profile, and albumin level, were ordered.

Three days before admission, the patient was placed on a soft diet in order to begin bowel preparation. Patients were maintained on a clear liquid diet and hospitalized the day before the procedure. On the night of the procedure, a fleet enema was performed, and a single dosage of a second-generation cephalosporin was administered one hour before induction of anaesthesia.

The sigmoid colon was resected proximally at the end of the left colon (Located by the start of the sigmoid mesocolon) utilizing non-crushing clamps (To maintain the colon's opening so it may pass the circular stapler's anvil) and distally at the rectosigmoid junction (With linear staplers 60 mm or contour staplers if available). Patients who failed to complete the distal end excision with a single staple firing, (Indicating a thick rectum), were eliminated and substituted with other patients.

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Through the proximal colonic end, a circular stapler's anvil (31 mm) was inserted, and a purse string was wrapped around it. The circular stapler was inserted transanaly, similar to a traditional double stapling method, and its spike was exteriorized by around 2 mm in front of the linear staple line's midpoint. A prolene suture (2/0-size) was passed at the midpoint between the spike and the rectal end from anterior to posterior and at the same position at the other end from posterior to anterior before being knotted (i.e., beginning and finishing at the same side of the spike penetration), to create an omega stitch **(Fig. 1).**

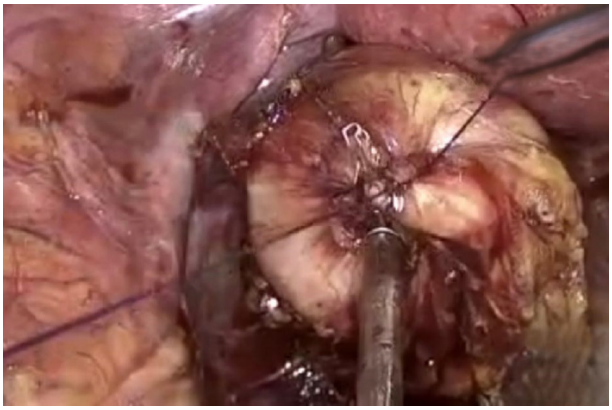

Fig 1: Completed omega stitch.

Consequently, the whole staple line was included into the circular stapler's knife. Thus, the staple line was severed inside the stapler's distal doughnut **(Fig. 2).**

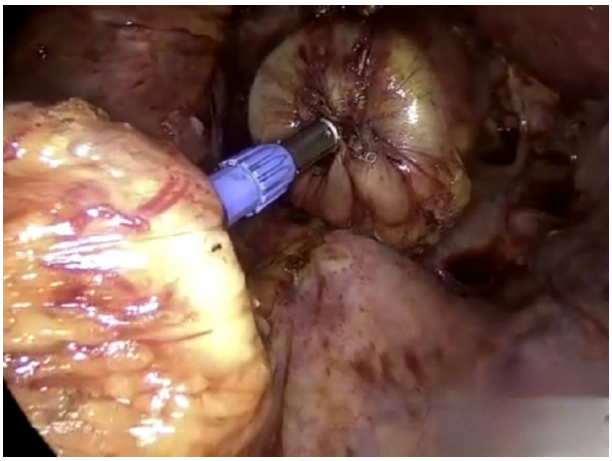

Fig 2: Incorporated distal staple line within distal doughnut.

Cases that developed suture line bleeding were managed by taking second layer sutures and were excluded to be replaced by other patients. A covering ileostomy was done for all cases and the abdomen was closed after insertion of a pelvic tube drain near (But not at) the site of the anastomosis. Patients were observed daily for vital stability, viability of the ileostomy and any signs that might suggest anastomotic complications (e.g., unexplained persistent abdominal rigidity, unexplained visceral pain, persistent nausea and vomiting beyond day 2 or Ryle tube daily output more than 200 cc if Ryle tube was inserted). Patients who developed complications for the ileostomy (Gangrene, obstruction, mucocutaneous separation, retraction) were excluded, managed according to their case and replaced by another patients. When the ileostomy began to function, patients were allowed to start fluid diet and were gradually transferred to regular diet. Routine labs (CBC, Na, K, serum albumin) were ordered every other day. Patients were discharged once they were on regular diet, with well-functioning stoma and within normal labs.

They were followed up in the outpatient clinic (OPC) weekly. After one month, a gastrograffin enema study was done to check for distal anastomosis integrity. In order to have the suture line form (With or without the dogears) as the only technical variable affecting the state of the anastomosis, the data of the study group was compared to the last thirty (30) correlated patients in our database, being careful to exclude patients who experienced suture line hemorrhage and/or had reinforcing sutures over the staple line.

Statistical analysis

Version 27 of IBM SPSS, the Statistical Package for Social Science, was used to collect, edit, code, and input the data. For parametric data, the mean, standard deviations, and ranges were displayed; for non-parametric data, the median and interquartile range (IQR) were displayed. Qualitative factors were also shown as percentages and numbers. The Chi-square test was used to compare the qualitative data between the groups. The Independent t-test was used to compare two independent groups with quantitative data and a parametric distribution, whereas the Mann-Whitney test was used to compare those with a non-parametric distribution. The variables linked to leak among the participants under study were evaluated using univariate and multivariate logistic regression analysis, with odds ratios (OR) and 95% confidence intervals (CI). A 95% confidence interval and a 5% acceptable margin of error were established. Therefore, the p-value was deemed significant at the <0.05 level.

Results

Within the study interval (From July 2024 till May 2025), the study group population were thirty (30) patients;18 males, and 12 females with different indications for sigmoid colon resection. The average age of the recruited patients was 49 years. **(Table 1, Fig. 3).**

Indications for sigmoid resection were variable,

incorporating both benign and malignant etiologies **(Table 2, Fig. 4).**

Consequently, the operative time varies greatly among recruited cases. The same fact applies for the requirement for intraoperative blood transfusion. The amount of blood transfused in such cases ranged from 1 to 3 packed RBCs units. Within the study group, six (6) patients required ICU admission and the reason for admission was strict postoperative follow up due to associated comorbidities. The average time needed for ileostomy to begin functioning; hence to start oral feeding was 3 days (2-4 days). Performing the gastrographin enema study one month postoperatively, revealed one case with contained leak **(Table 3, Fig. 5).**

That case responded well to conservative treatment and didn`t require reintervention **Table 4**. Searching for possible risk factors for leak, further sub-analysis for cases who developed leak, was carried on **(Tables 5,6, Figs. 6,7).**

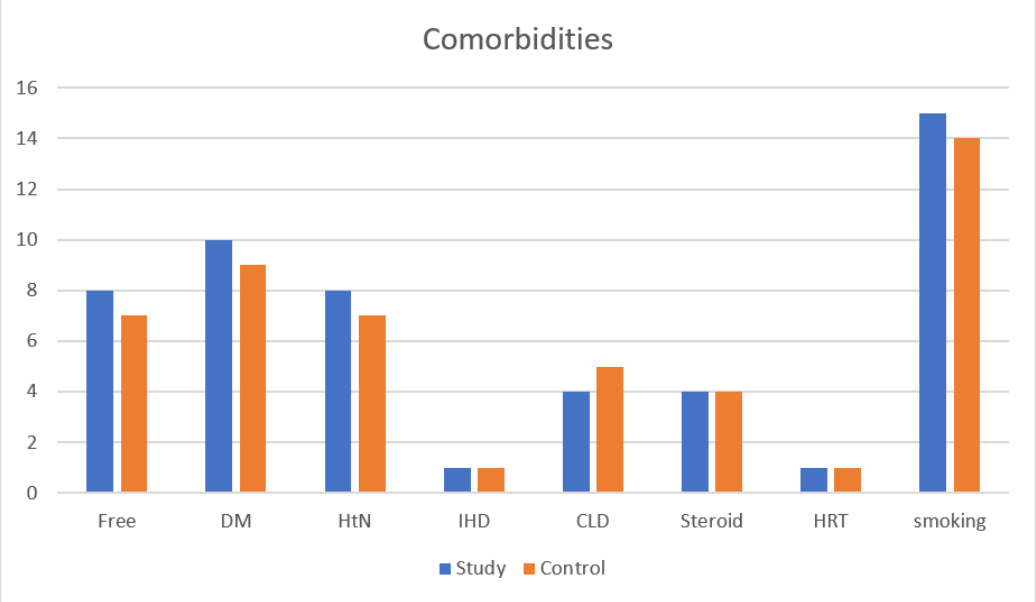

Fig 3: Comorbidities.

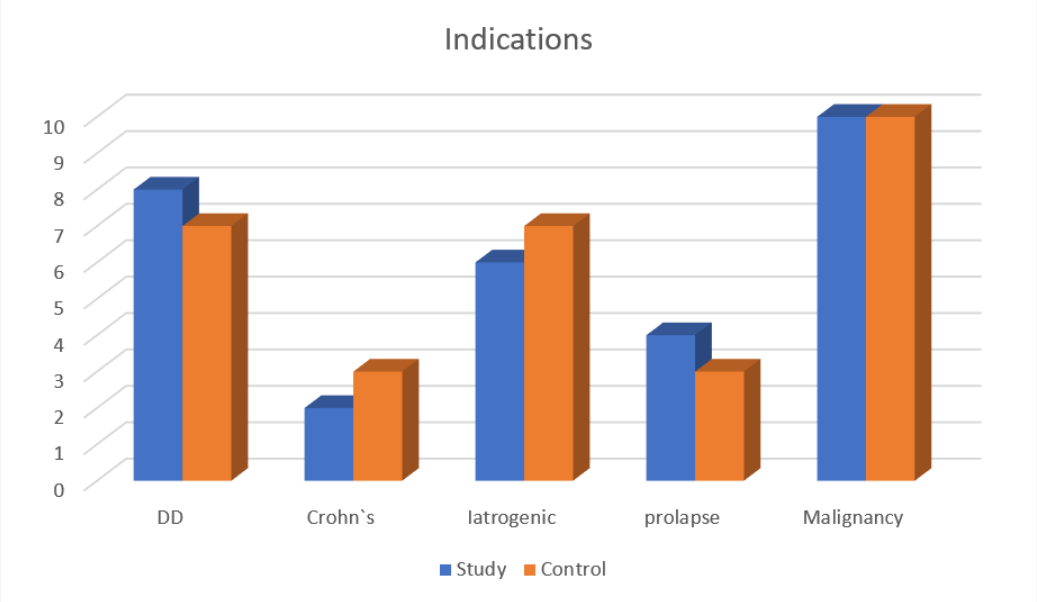

Fig 4: Indications for sigmoid resection.

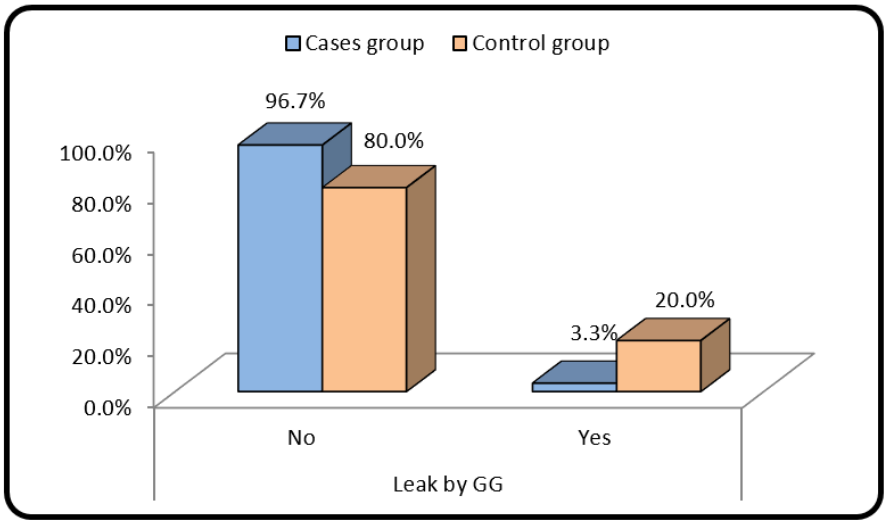

Fig 5: Percentage of leak.

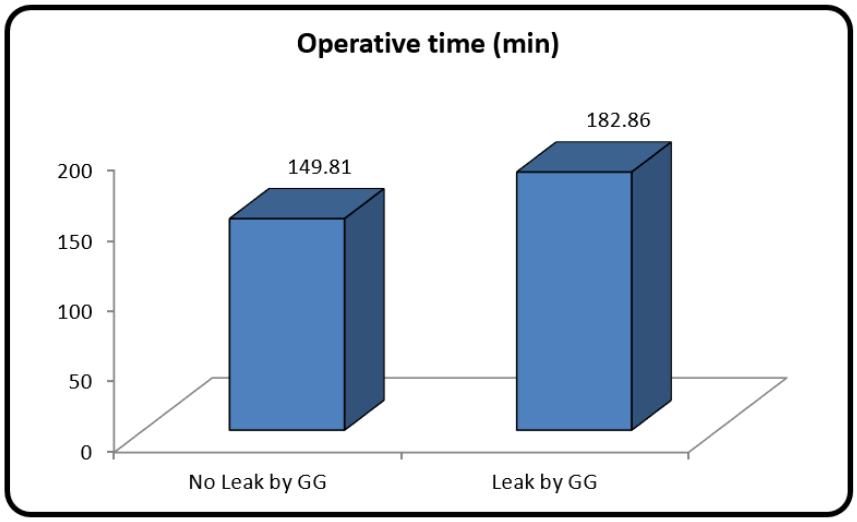

Fig 6: Operative time and incidence of leak.

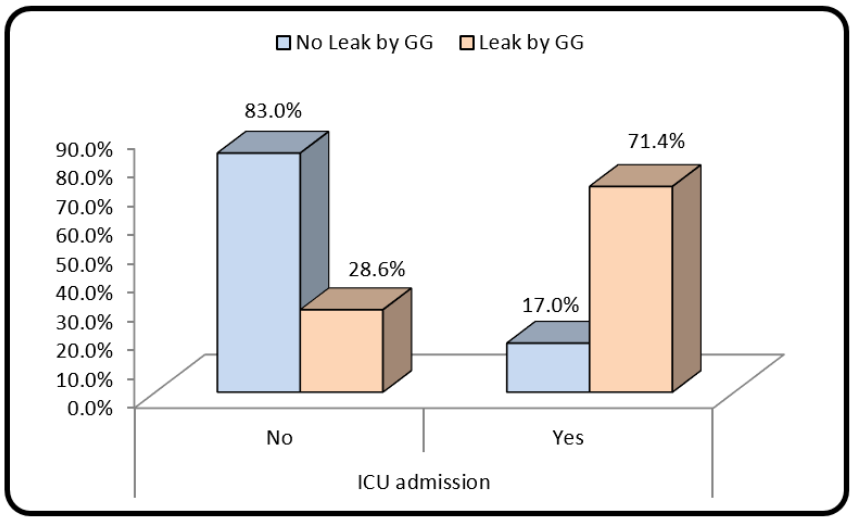

Fig 7: ICU admission and incidence of leak.

Table 1: Demographic data of study population

		Cases group	Control group	Test value	P-value	Sig.
		No. = 30	No. = 30			
Gender	Female	12 (40.0%)	13 (43.3%)	0.069*	0.793	NS
	Male	18 (60.0%)	17 (56.7%)			
Age	Median (IQR)	49 (41 – 57)	55 (45 - 67)	-0.747≠	0.455	NS
	Range	29 – 67	32 – 70			
Comorbidities	No	8 (26.7%)	7 (23.3%)	0.089*	0.766	NS
	Yes	22 (73.3%)	23 (76.7%)			
HTN	No	22 (73.3%)	23 (76.7%)	0.089*	0.766	NS
	Yes	8 (26.7%)	7 (23.3%)			
DM	No	20 (66.7%)	21 (70.0%)	0.077*	0.781	NS
	Yes	10 (33.3%)	9 (30.0%)			
CLD	No	26 (86.7%)	25 (83.3%)	0.131*	0.718	NS
	Yes	4 (13.3%)	5 (16.7%)			
Steroid therapy	No	26 (86.7%)	26 (86.7%)	0.000*	1.000	NS
	Yes	4 (13.3%)	4 (13.3%)			
IHD	No	28 (93.3%)	28 (93.3%)	0.000*	1.000	NS
	Yes	2 (6.7%)	2 (6.7%)			
HRT	No	30 (100.0%)	30 (100.0%)	–	–	–
	Yes	0 (0.0%)	0 (0.0%)			
SLE	No	30 (100.0%)	29 (96.7%)	1.017*	0.313	NS
	Yes	0 (0.0%)	1 (3.3%)			
Smoking	No	15 (50.0%)	16 (53.3%)	0.067*	0.796	NS
	Yes	15 (50.0%)	14 (46.7%)			
ASA	I	10 (33.3%)	9 (30.0%)	0.077*	0.781	NS
	II	20 (66.7%)	21 (70.0%)			

P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant

*: Chi-square test; •: Independent t-test; ≠: Mann-Whitney test.

Table 2: Indications of resection

		Cases group	Control group	Test value	P-value	Sig.
		No. = 30	No. = 30			
Indication of resection	DD	8 (26.7%)	7 (23.3%)	0.486*	0.975	NS
	Iatrogenic (colonoscope)	6 (20.0%)	7 (23.3%)			
	Rectal prolapse	4 (13.3%)	3 (10.0%)			
	Crohns	2 (6.7%)	3 (10.0%)			
	Sigmoid cancer	10 (33.3%)	10 (33.3%)			
Operation	Sigmoidectomy	30 (100.0%)	30 (100.0%)	–	–	–

P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant *: Chi-square test; •: Independent t-test.

Table 3: Perioperative data

		Cases group No. = 30	Control group No. = 30	Test value	P-value	Sig.
Blood transfusion	No	22 (73.3%)	22 (73.3%)	0.000*	1.000	NS
	Yes	8 (26.7%)	8 (26.7%)			
No. of blood transfusion units	Mean ± SD	1.75 ± 0.71	1.63 ± 0.74	0.344•	0.736	NS
	Range	1–3	1–3			
Operative time (min)	Mean ± SD	153.83 ± 32.32	153.5 ± 33.04	0.040•	0.969	NS
	Range	110–220	110–210			
ICU admission	No	24 (80.0%)	22 (73.3%)	0.373*	0.542	NS
	Yes	6 (20.0%)	8 (26.7%)			
Stoma function (days)	Mean ± SD	2.77 ± 0.73	2.87 ± 0.86	-0.486•	0.629	NS
	Range	2–4	2–5			
Leak by GG	No	29 (96.7%)	24 (80.0%)	4.043*	0.044	S
	Yes	1 (3.3%)	6 (20.0%)			

Table 4: Cases with concealed leak

Factor	Study group (n=1)	Control group (n=6)
Sex (M:F)	1:0	2:4
Age (years)	65	39-67
Comorbidities	HTN=1, Steroid=1 CLD=1	DM=4 HTN=2 steroid=2
Smoking	Yes=1	Yes=4, No=2
ASA score	II	II
Diagnosis	Cancer=1	Crohn`s=1 DD=1 Iatrogenic=2 Cancer=2
Blood transfusion (no., of units)	Yes=1 (2)	Yes=3 (1, 1, 3), No=3
Operative time (min)	165	181
ICU admission	Yes	Yes=4, No=2

Table 5: Possible risk factors for leak

		No Leak by GG No. = 53	Leak by GG No. = 7	Test value	P-value	Sig.
Blood transfusion	No	41 (77.4%)	3 (42.9%)	3.764*	0.052	NS
	Yes	12 (22.6%)	4 (57.1%)			
No. of blood transfusion	Mean±SD	1.5 ± 0.52	2.25 ± 0.96	-2.027•	0.062	NS
	Range	1 - 2	1 - 3			
Operative time (min)	Mean±SD	149.81 ± 32.08	182.86 ± 16.8	-2.664•	0.010	S
	Range	110 - 220	150 - 200			
ICU admission	No	44 (83.0%)	2 (28.6%)	10.247*	0.001	HS
	Yes	9 (17.0%)	5 (71.4%)			
Stoma function (days)	Mean±SD	2.81 ± 0.81	2.86 ± 0.69	-0.143•	0.887	NS
	Range	2 - 5	2 - 4			

P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant *: Chi-square test; •: Independent t-test.

Table 6: Univariate and multivariate logistic regression analysis for factors associated with leak

	Univariate				Multivariate*			
	P-value	OR (95% CI)	95% C.I. for OR		P-value	OR (95% CI)	95% C.I. for OR	
			Lower	Upper			Lower	Upper
Operative time > 175 min	0.010	18.462	2.030	167.877	0.031	12.499	1.264	123.582
ICU admission	0.006	12.222	2.041	73.185	0.039	7.666	1.111	52.883

OR: Odds ratio; CI: Confidence interval; *: Adjusted for age.

Discussion

What represents lower gastrointestinal leak after colorectal anastomosis is still a matter of debate.[13] For standardization, we adopted the definitions proposed by the United Kingdom Surgical Infection Study Group,[14,15] and endorsed by the Spanish Perioperative Audit and Research Network (REDGERM),[16] i.e., leaks are "clinical" when contents of two hollow viscera are communicated, whereas; it is "subclinical" when the escaping contents are localized and only detected radiologically with no clinical manifestations.[13]

The incidence of such horrific complication was estimated to decrease significantly from 30% in 2009,[17] to about 3% in 2017.[18]

It was about 3.3% within our study group (1 case) despite our small sample size being a pilot study. This can be attributed to better understanding of the predisposing risk factors and technical innovations.[19]

Although some of those risk factors are "nonmodifiable" especially the distance of the anastomosis from the anal verge, the human factor still has a great role.[20]

This is why stapled anastomosis, especially in colorectal cases, is preferred in many centers. Estimated advantages of stapled anastomosis include shorter operative time, consistent stapling bite distance, accepted cost-effectiveness and applicability with no significant difference in the incidence of anastomotic leak in comparison to handsewn techniques.[21]

It is worth to mention that the previously mentioned advantages were not enough to demonstrate superiority of stapled techniques in recent Cochran reviews.[22]

Initially described by Knight and Griffen 6, the "double stapling" technique is widely accepted among colorectal surgeons for reconstruction after sigmoid colon resection. The resulting dogears at the site of staple line crossing, is a potentially ischemic part, raising the incidence of anastomotic leak (AL).[8]

These "ischemic points" are potential site of local recurrence from oncological point of view in case of malignant lesions.[23]

Attempts to excise such "dogears" were reported by suturing them to the staple line near the site of anvil exit.[8,24,25]

Wei et al suggested to substitute the linear cutting stapler step by bowel resection using Ligasure and performing a puse-string at both ends before applying the circular stapler.[23]

Zhang et al tried initial rectal stump invagination before application of the circular stapler.[26]

Asao et al suggested the application of an omega suture after linear staple cutting, instead of the purse string.[11,12]

However, the classic "Knight and Griffen" is the most commonly applied technique all over the world, including our institute. In our research, we reintroduced the "omega suture" technique demonstrating its safety and feasibility. Trying to have the operative technique as the only effective variable compared between the study and controlled groups, a strict inclusion and exclusion criteria was adopted for the "correlated" patients to be recruited starting from the indication for sigmoid resection. Emergent cases were excluded to have the patients "fully optimized" preoperatively.

The only exception was emergent cases of iatrogenic sigmoid perforation during colonoscopy as the patients were, already, adequately prepared. It is well established that emergency operation setting per se, is a risk for colorectal anastomotic failure.[27]

Cases with previous laparotomy, and hence needing adhesiolysis during the sound operation, were also excluded. Adhesiolysis increases the incidence of complications.[28]

This implies to exclude cases with recurrent cancer and those on chemoradiotherapy. Preoperative colon preparation was done for all patients recruited for the study.

Despite the ongoing debate about its value, mechanical bowel preparation with preoperative oral

antibiotics was done to reduce surgical site infection and postoperative anastomotic complications.[29]

We excluded patients requiring more than one linear staple firing for rectal end resection because it (Multifire stapling), was supposed by many researchers to be an independent risk factor for anastomotic failure.[30,31]

In our practice, it is not a routine to take a second layer sutures for reinforcement after circular stapler firing. Recent studies failed to find any advantage for such "reinforcement" technique.[32]

It is worth mentioning that cases who developed suture line haemorrhage, were excluded from both the study and control groups, as such cases were usually managed by taking a "second layer" of sutures. Stoma-site complications may indicate poor healing and ischemic colitis. For that reason, we decided to exclude such patients after initially excluding patients with BMI more than 35 while recruiting the study group. Perioperative blood transfusion is identified as a risk factor for anastomotic leak (Our primary aim for comparison), either directly via immunologic mechanisms ending by delayed anastomotic healing, or indirectly as a surrogate for "operative difficulty".[33] Such a point was taken in account while recruiting our study and control group. However, we didn`t find such a relation. The research included patients with different indications for sigmoid colon resection, either benign or malignant. This allowed us to examine the feasibility of the omega suture technique over a wide variety of cases. Despite the small sample size, we found correlation between anastomotic leak and ICU admission; a finding confirmed by many researchers.[34,35]

One case of concealed leak (6 cases in the control group) was diagnosed during the follow up radiology. Separate analysis of those patients (Both control and study group cases) revealed two important points: The incidence of leak in the control group was significantly higher than the study group. The second point was the significant correlation between leak and ICU admission. This may be a reverse correlation i.e.; anastomotic leak was the actual initiator that led to ICU admission and not the reverse.[36-39]

This would imply to have a more frequent postoperative visit for those giving history of postoperative ICU admission following colorectal resection. Taking in account the simplicity of the procedure; applying an omega suture to the stapler line, the omega suture technique is feasible, safe and can be an important step to reduce the incidence of failure of stapled colorectal anastomosis.

Limitations

Being a pilot study, implies to include small number of patient while trying to investigate the feasibility and safety of the omega technique during colorectal stapled anastomosis performance. We adopted a very strict inclusion and exclusion criteria to have the surgical technique as the only effective variable between the study and control groups. Postoperative stoma site complications can be related to many causes other than ischemic colitis. Having the control group data extracted from the data base implies two limitations: the surgical team is not the same in both group and the risk of selection bias cannot be denied. Our study is a controlled study with no randomization of the patients. All of these limitations can be mitigated in later studies having demonstrated the feasibility and safety of the technique before recommending such a technique as a standard one.

Conclusion

Excising the anastomosis dog-ears using the omega technique is feasible and can reduce the incidence of anastomotic leak after stapled colorectal surgeries

List of abbreviations

DST: Double stapling technique
OPC: Outpatient clinic
ASA: American society of anaesthesiology
BMI: Body mass index
CBC: Complete blood count
Na: Sodium
K: Potassium
IQR: Inter quartile range
OR: Odd ratio
CI: Confidence interval

Disclosure

The authors have no disclosure

Conflict of interests

There is no conflict of interests.

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