A RANDOMIZED STUDY COMPARING SYNTHETIC AND BIOLOGICAL MESHFOR INCISIONAL HERNIA AVOIDANCE FOLLOWING CLOSURE OF LOOP-ILEOSTOMY

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Abstract:

Objective: Hernia prevention is necessary since the incisional hernia is a frequent result of loop-ileostomy closure. In order to avoid difficulties connected to synthetic mesh usage, the biological mesh has been employed extensively in polluted surgical sites. Prior research on meshes, however, doesn't really corroborate this method. The pre-loop experiment was developed to test the efficacy and safety of biological mesh (BM) vs synthetic mesh (SM) in preventing incisional hernias after loop-ileostomy closure.

Methods: Preloop randomized feasibility trial, a ground-breaking study, was carried out at four hospitals in Lahore, Pakistan, from August 2019 to March 2023. To take part in the trial, 102 people who had had anterior rectal cancer excision and had a temporary loop ileostomy were chosen. The patients had ileostomy closure with a 1:1 ratio of either a biological mesh or a synthetic polypropylene mesh were placed in the retro rectus region. In addition to evaluating the prevalence of surgical site infections within 30 days following the procedure, the research sought to ascertain how well the two mesh types performed in avoiding incisional hernias throughout a 10-month follow-up period.

Results:97 of the 102 patients who were randomly assigned obtained the desired allocation. A total of 94 (97%) patients were assessed at the 30-day follow-up. 1 out of 46 (2%) of the SM group had SSI. 38 out of 46 (86%) of the patients in the SM group reported an uneventful recovery. In the BM group, 2 out of 48 (4%) patients experienced SSI (p-value > 0.90), while 43 out of 48 (90%) patients reported an uncomplicated recovery. One patient from each group had their mesh removed (p-value > 0.90).

Conclusions: After loop-ileostomy closure, SSI was safe using both biological and synthetic mesh. When the participants in the trial have finished the 10 months of follow-up, the effectiveness of hernia prevention will be reported.

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Introduction:

Incisional hernia (IH) is a complication following loop-ileostomy closure that affects between 5% and 30% of patients [1-3] and may need further surgery in up to 20%–40% of patients [4-6]. IH rate, however, may not be accurately recorded [4, 7]. High BMI and ASA class 3–4 (American Society of Anesthesiologists) status are risk factors for IH [2, 8].

In a randomized controlled study that included clean and clean contaminated ventral hernia repair, synthetic mesh did not raise the likelihood of surgical site occurrence when relative to biological mesh [9-14]. IH prevention during temporary stoma closure with a specific kind of medical mesh hasn't been extensively studied up to this point. IH rates were reported to be 6% with synthetic polypropylene mesh and 36% without mesh in controls in another investigation [15,16]. In a similar vein, a research found that after using different stoma closure procedures, hernia rates were 1% with a synthetic mesh (SM) and 17% without mesh [17]. In a case-control study, a biological mesh (BM) was employed in the retro rectus position, and the hernia rate was 3% in the BM group against 19% in the control group [18]. In a study, intra-abdominal BM was contrasted with a control group that had surgery without the use of preventive mesh [19]. In contrast to the non-mesh group, which had a higher IH rate of 20%, the BM group had a lower IH rate of 12%. Shaw et al. employed synthetic prophylactic mesh in the recto rectus region for 20 individuals in a prospective case study. The average follow-up time was 20 months [20], and no surgical site complications were reported throughout that time. In a recent comprehensive investigation, the use of preventive mesh was shown to be safe in terms of SSI, seroma, and anastomotic leakage [21]. Also, compared to non-mesh closure, mesh closure reduced the hernia rate.

At polluted surgical sites, biological meshes have traditionally been preferred over synthetic ones. Clinical data, however, contradict the practice [22,23]. Synthetic meshes may also be more affordable and more effective in preventing hernias than natural meshes [24-28].

The purpose of this Pre-loop trial research is to assess the efficacy and safety of biological and synthetic mesh in preventing incisional hernia after temporary loop ileostomy closure. It is a non-inferiority study that will assess both short and long-term outcomes.

Methods:

Study Design: The Preloop experiment, a well-designed trial, sought to assess the efficacy and safety of a new strategy for preventing incisional hernias (IH) after loop-ileostomy closure. The study's rigorous methodology, which included randomization, control, and multicenter recruiting to make sure the findings were reliable and broadly applicable, was what made it stand out.

The research aimed to give a complete approach to IH prevention by integrating synthetic mesh (SM) and biological mesh (BM) in the retrorectus area. Since that it is often the location of IH development and is difficult to surgically correct, it was decided to concentrate on this particular region. The research's main finding is that SM, a less costly alternative, is equally as secure and reliable as the more pricey BM in preventing IH after loop-ileostomy closure.

The Clavien-Dindo classification and the Centers for Disease Control and Prevention (CDC) criteria for surgical site infections (SSIs) were used to categorize and grade SSIs throughout the 30-day follow-up period in order to assure the study's correctness and dependability. The main goal of the research was to ascertain the prevalence of hernias, both medically and via a CT scan, and the incidence of incisional hernias throughout a 10-month period after stoma

closure. The study evaluated a number of secondary outcomes in addition to the primary ones, such as the frequency of hernia over a five-year follow-up period, other complications graded using the Clavien-Dindo classification within 30 days of surgery, quality of life as assessed by the RAND-36, operating time, length of stay, and frequency of revision surgery.

The Preloop study is crucial because it will provide light on the efficacy and safety of SM and BM in IH prevention after loop-ileostomy closure, guiding clinical practice and perhaps lowering healthcare expenditures. The trial's strict methodology and use of many outcomes highlight its significance as a significant addition to the area of surgery.

At four hospitals in Lahore, Pakistan, the study's subjects had operations. For inclusion, all patients with rectal cancer who underwent anterior resection with complete mesorectal excision and preventative loop-ileostomy (older than 18 years) were taken into account (Figure 1). Exclusion criteria included having an ASA class IV-V, having or having had another malignant tumor within the preceding five years, having a T4b tumor that required the removal of several organs, having an emergency operation, having primary rectal surgery with significant concurrent procedures (such as a hepatectomy or other intestinal resection), having the metastatic illness, and being pregnant. Those getting adjuvant chemotherapy weren't included at first. Nonetheless, it was determined to additionally enroll such patients in the research after an interim safety review revealed that there had been no unfavorable patient events.

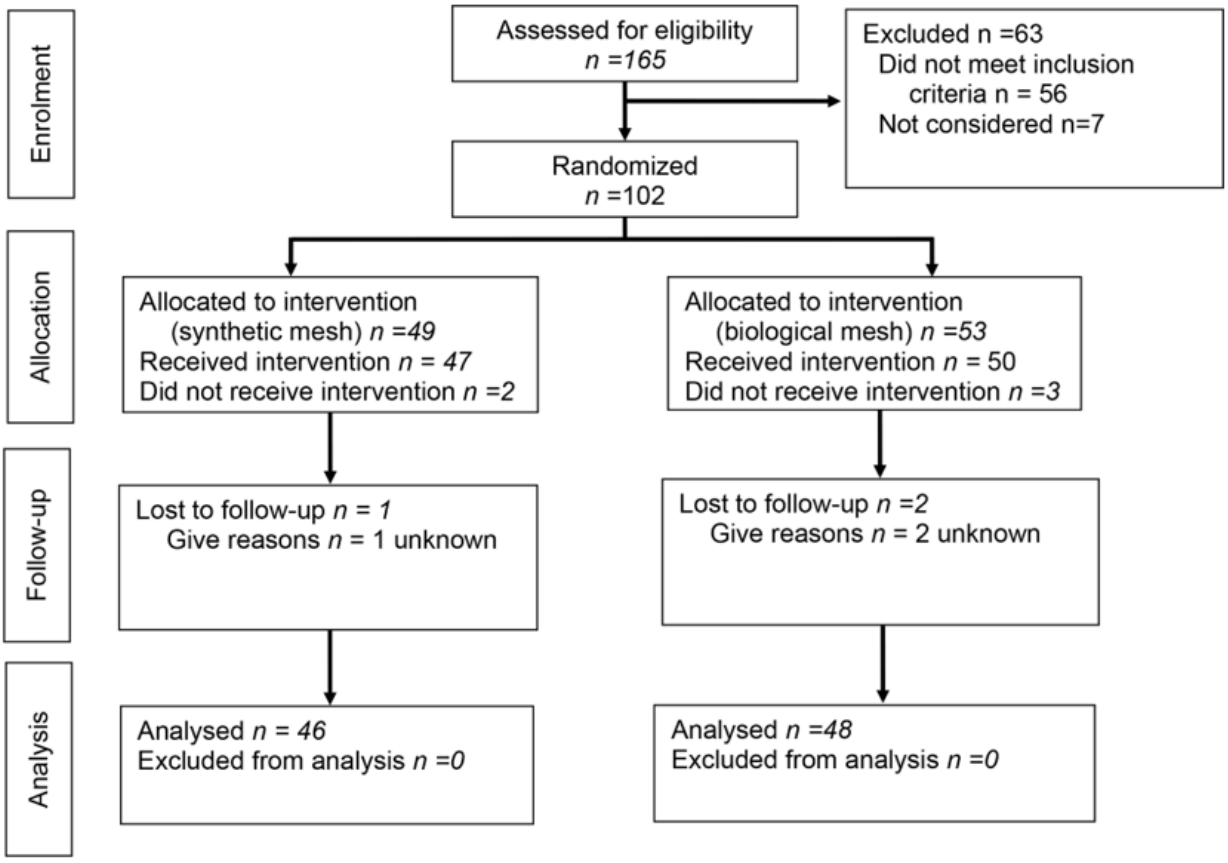

Figure 1: Flow Chart

The research was planned as a 1:1 randomization non-inferiority trial of feasibility. The closure of a loop ileostomy in eligible individuals was randomized to either BM in the

retrorectus space or synthetic lightweight mesh. Each research center's randomization list was created separately. The trial participants were divided into research groups using a computer-generated list to guarantee fair and accurate randomization. A biostatistician who was not involved in the patients' clinical treatment produced this list. Between 2, 4, and 6, the block sizes were arbitrarily changed, and the randomization procedure was carried out in blocks. While the randomization group was indicated in the medical records of the patients, measures were taken to guarantee that neither the staff nor the patients were aware of the group assignments during the follow-up period. This strategy was used to reduce bias and preserve the reliability of the study's findings.

Statistical Analysis: The intention-to-treat (ITT) principle was used as the main guideline for all analyses. The subjects were examined in a randomized sequence for the ITT analysis. To prevent the possibility of making a fraudulent claim of non-inferiority, per-protocol analyses were also carried out. Using the proper statistical tests, the study's data analysis compared continuous and categorical variables between the groups. Continuous variables were analyzed using either the Mann-Whitney U-test or the Student's t-test, depending on whether the data matched the homogeneity assumption. The Mann-Whitney U-test was performed in the case of heterogeneity. The $\chi 2$ or Fisher's exact test or test was used to categorical data to identify any significant differences between the research groups. Continuous data that had been measured multiple times was evaluated using a linear mixed model (LMM), which included people as random effects. These statistical methods were chosen to ensure accurate and reliable analysis of the data.Akaike's information criterion was used to determine the covariance pattern for LMM. P values with two tails are presented. SAS v.9.4 and SPSS v.26 were used for the analyses.

Results:

The enrollment and randomization of 102 individuals were placed between August 2019 to March 2023. Thirty days after receiving the prescribed intervention, which was administered to a total of 97 patients, 94 individuals were evaluated (Figure 1). The patient characteristics for the two randomization groups are listed in Table 1. Contamination class II was assigned to all operations (clean-contaminated). Table 2 contains information on the operations and discharge.

During the 30-day follow-up, there were a total of 3 patients with SSI, 2 (4%) in the BM group and 1 (2%) in the SM group (p-value > 0.90). One patient in the SM group required a second surgery and mesh removal because ofClavien-Dindo 4 anastomotic leaking. An oral antibiotic-treated Clavien-Dindo 2 superficial chronic wound was one of the complications in the BM group. The other required a repeat procedure and mesh removal due to a Clavien-Dindo 3b abscess. By the 30-day follow-up, the total number of patients in the SM group was 38 (86%), and the total number of patients in the BM group was 43 (90%). (Table 3). 2 patients in the SM group had to be readmitted because of rectal bleeding and the aforementioned anastomotic leaks. A patient with SSI was readmitted after being discharged from the BM group. There were no variations in the length of stay, operational time, or challenges between the groups. Table 2 provides a summary of all outcomes. In following trial-related publications, quality of life and changes to it after recovery will be discussed as a secondary outcome.

Table 1: Demographic information of the patients included in the study

	Biological Mesh (BM)			**Synthetic Mesh (SM)**		
	Mean± SD	**n**	**%**	**Mean± SD**	**n**	**%**
Gender						
Male		32	64		29	62

Female		18	36		18	38
Age (Years)	66 ± 11.6			62 ± 9.1		
Adjuvant therapy		9	18		8	17
Previous hernia		7	14		2	4
Smoker		3	6		4	9
Immunosuppression		3	6		1	2
Diabetes		8	16		4	9
Asthma/COPD		2	4		3	6
High blood pressure		22	47		25	50
ASA class	2.2 ± 0.6			2.2 ± 0.6		
BMI	25.6 ± 4.7			25.5 ± 4.06		

Table 2: Information about patients' operation and recovery

	Biological Mesh (BM)			**Synthetic Mesh SM)**			**P-value**
	Mean± SD	n	%	Mean± SD	n	%	
Hospital Stay (Days)	3.3 ± 0.3			3.2 ± 0.3			0.91
Discharge		46	98		46	96	> 0.90
Ileus during the hospitalization		5	11		8	16	0.42
During stoma closure, parastomal hernia was found.		8	16		5	11	0.31
Mesh insertion time(min)	15.1 ± 11.3			13.3 ± 7.0			0.35
Operation time (min)	76 ± 25.8			79 ± 25.8			0.51
Interval since anterior resection (months)	4.4 ± 2.6			4.1 ± 2.2			0.45

Table 3: 30 days follow up outcomes

		SM		**BM**		**Difference**	**CI**	**p-value**
		n	**%**	**n**	**%**			
	Mesh removed	1	2	1	2	0.1	-8.9 to 9.4	> 0.90
	Reoperation	1	2	1	2	0.1	-8.9 to 9.4	> 0.90
	Readmission	2	4	1	2	2.3	-7.1 to 12.6	0.61
	SSI	1	2	2	4	-2	-12.0 to 7.7	> 0.90
Wound status	**Pain, erythema**	1	2	0				
	wound exposed at the level of the fascia	2	4	2	4			
	Wound just partially opened.	5	11	3	6			
	Completely healed	38	83	43	90	7	-7.4 to 21.5	

Discussions:

According to the 30-day Preloop study findings, using synthetic mesh (SM) at contaminated surgical sites is safe and effective at avoiding incisional hernias on par with biological mesh (BM) (IH). When the surgical site contamination was taken into consideration, the full wound healing rate was acceptable in both groups. These findings are noteworthy because they imply that SM can be a more affordable option than BM for preventing IH after loop-ileostomy closure.

This trial's randomized multi-center design, which allowed for a homogeneous patient group and uniform operating procedures, is one of its key features. The research is nonetheless constrained by the small patient populations in both groups and the non-blinded design. The mesh size was fixed for all patients, regardless of the extent of the defect, and the BM was smaller than the SM in width. This could have influenced the outcomes of hernia prevention studies.

Despite these restrictions, there were no differences in the two groups' problems, wound healing rates, hospital stays, or operating times. The price of the mesh was the only factor that made a difference in the immediate outcomes. Any changes in reoperations andIH rate linked to IH and mesh problems will be revealed by longer-term follow-ups.

According to this study's early results, employing the more costly biological mesh (BM) at loop-ileostomy closure sites or contaminated surgical sites during short-term follow-up may not be warranted in all patients. The usage of synthetic mesh (SM) could be equally as beneficial, according to the data gathered. To validate these findings and assess the long-term effects of utilizing various mesh types in diverse surgical situations, more study is required.

SM is an attractive alternative for surgical teams to think about because of the possible cost savings and similar effectiveness during short-term follow-up. Yet, while choosing a course of therapy, it is important to carefully consider the complexity of surgical situations as well as the unique characteristics of each patient. The investigation's findings may eventually help to improve decision-making and result in better patient outcomes and more affordable healthcare delivery. This conclusion is important for policymakers and healthcare professionals because it raises the possibility that using SM might lower healthcare expenses without sacrificing patient outcomes. The Preloop trial provides important information on the use of SM and BM in IH prophylaxis after loop-ileostomy closure and emphasizes the need for more research in this area.

Conclusions:

Incisional hernias (IH) may be prevented at loop-ileostomy closure sites using lightweight synthetic mesh (SM), according to the Preloop trial's results. This is noteworthy because it refutes the widely held notion that biological mesh (BM) is the sole practical method for preventing IH. The long-term follow-up will show if the cost-saving advantages of SM exceed any possible quality-of-life drawbacks. These positive findings should prompt additional research into the efficiency of SM in other polluted surgical sites.

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