

Research Journal of Pharmaceutical, Biological and Chemical Sciences

A Study To Compare The Efficacy Of Two Suturing Techniques In Reducing The Development Of Postoperative Complications Among Patients With Generalized Peritonitis Who Underwent Midline Laparotomy In A Tertiary Center In South India.

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ABSTRACT

The abdominal cavity has rightly been compared to Pandora's Box. Innumerable processes are simultaneously at work to maintain a physiological milieu compatible with life. Various extrinsic and intrinsic insults can lead to disease and affect the normal functioning of abdominal organs. Many abdominal disease processes demand surgical correction in the form of a laparotomy. Even today, diagnostic surgical exploration is sometimes necessary. Vertical midline incisions have long been popular. This is because of the ease and expediency with which they can be made and closed. A midline approach provides access to all quadrants of the abdomen. It avoids devascularization and denervation during incision or closure. The incision can be extended easily when necessary. The chief disadvantage of the midline incision is the common occurrence of wound disruption and incisional hernia. To determine the association between the suturing techniques and postoperative complications and to see if interrupted closure led to fewer postoperative complications. This retrospective non-randomized study compares the efficacy of two suturing techniques: continuous and interrupted (in current use) in reducing the development of post-operative complications among patients with generalized peritonitis who underwent midline laparotomy while admitted in the General Surgical Units of Panimalar Medical College Hospital and Research institute in the year between March 2021 to March 2023. In the 100 subjects for whom No. 1 Prolene / Nylon was used for closure, 50 were found to have closure by the interrupted technique and 50 by the continuous technique. At the end of the pilot study modifications were made in the instrument. More risk factors of wound healing included: diabetes mellitus, hypertension, jaundice, renal failure, pulmonary disease, anemia, hypoalbuminemia, enteric fever, heart disease, malignancy, presence of stoma, admission to the surgical intensive care unit (SICU), need for mechanical ventilation. This study shows that the interrupted technique of fascial closure is superior to the continuous technique in the prevention of both early and late wound complications in a contaminated wound. Further larger studies are indicated to demonstrate statistical significance. Various modifiable risk factors have been described to decrease the rate of development of post-operative wound complications.

Keywords: Midline laparotomy, Peritonitis, Wound dehiscence

<https://doi.org/10.33887/rjpbcs/2023.14.6.79>

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INTRODUCTION

Despite advances in surgical technique and materials, abdominal fascial closure has remained a procedure that often reflects a surgeon's preference with a reliance on anecdotal experience. The ideal technique, although suggested by surgical literature has not been uniformly accepted.[1] A sound suture technique should hold good in all circumstances, i.e., both in clean and contaminated wounds. The efficacy of a particular technique may be measured by the incidence of early and late wound complications.[2] Early complications include wound infection, wound dehiscence, and burst abdomen; whereas late complications include incisional hernia, suture sinus, and wound pain.[3] This study seeks to allocate patients into two groups: one, in which the continuous technique is used for the closure of the linea alba, and the other in which an interrupted technique is used. The study aspires to observe and record wound complications after midline laparotomy incisions in the hope of spurring renewed interest in abdominal closure and possibly gathering evidence that warrants change in the current trend, or evidence encouraging the ongoing practice.[3] Various factors predispose an individual to these post-operative wound complications. These include a patient's demographic profile, co-morbid illness, lifestyle factors, and surgical technique.[4] Over the ages, newer and more efficacious suture materials have been introduced. [5] During the turn of the twentieth century, absorbable catgut suture was state-of-the-art. It was phased out only when Goligher decried its usage due to frequent wound dehiscence. Next began the era of non-absorbable suture materials, initially in the form of stainless steel and later on synthetic non-absorbable sutures with better handling characteristics and wound security. [6,7]

MATERIALS AND METHODS

This retrospective non-randomized study compares the efficacy of two suturing techniques: continuous and interrupted (in current use) in reducing the development of post-operative complications among patients with generalized peritonitis who underwent midline laparotomy while admitted in the General Surgical Units of Panimalar Medical College Hospital and Research institute in the year between March 2021 to March 2023. In the 100 subjects for whom No. 1 Prolene / Nylon was used for closure, 50 were found to have closure by the interrupted technique and 50 by the continuous technique. At the end of the pilot study modifications were made in the instrument. More risk factors of wound healing included: diabetes mellitus, hypertension, jaundice, renal failure, pulmonary disease, anemia, hypoalbuminemia, enteric fever, heart disease, malignancy, presence of stoma, admission to the surgical intensive care unit (SICU), need for mechanical ventilation

Inclusion Criteria

- Patients over 15 years of age.
- Suture material must be No 1 Prolene/Nylon.
- The suturing technique must be either interrupted or continuous.
- Subjects who had a post-operative follow-up of at least 10 days.
- Subjects who expire within the first 10 days due to a complication under study.

EXCLUSION CRITERIA

- Subjects with localized peritonitis.
- Subjects who underwent any incision other than midline laparotomy.
- History of previous operation using a midline incision.

The subjects were identified from their case records and the operation notes as entered by the operating surgeon. As this was an observational study, patients were included in each arm of the study based on the technique of fascial closure at the discretion of the operating surgeon. All the subjects who fulfilled the inclusion criteria were included in the study. The investigator explained the nature and purpose of the study, assured the confidentiality of the subject, and obtained verbal consent. The details of the subject were then obtained from the subjects' case record.

Statistical Analysis

Descriptive statistics were used to present the post-operative complications. The chi-square test was used to determine the association between the suturing technique used and the post-operative complications. The association between the postoperative complications and the demographic and clinical variables was assessed using a chi-square test.

RESULTS

Over half of the subjects (62.2%) were 45 years of age or less, while elderly subjects represented only 12.6% of the study sample. This demonstrates that most of the subjects (78.8%) were men while only 21.2% were women. The site of perforation leading to peritonitis in the majority of subjects was the duodenum (57%). Other significant causes were appendicular (15.9%) and ileal (11.3%) perforations. The above figure demonstrates that 22.5% of the subjects developed wound infection, 12.6% had wound dehiscence, 4.6% had burst abdomen, and 9.9% of the subjects developed incisional hernia. The interrupted technique was used for 61 out of 151 (40.4%) subjects, whereas the continuous technique was used for the remaining 90 subjects (59.6%)

Table 1: Prevalence of risk factors

| S.No | Clinical Variables | Yes | % |
|------|------------------------|-----|------|
| 1. | Diabetes Mellitus | 11 | 7.3 |
| 2. | Hypertension | 9 | 6 |
| 3. | Jaundice | 11 | 7.3 |
| 4. | Renal Failure | 23 | 15.2 |
| 5. | Pulmonary Disease | 44 | 29.1 |
| 6. | Anemia | 22 | 14.6 |
| 7. | Hypoalbuminemia* | 41 | 85.4 |
| 8. | Enteric fever | 8 | 5.3 |
| 9. | Heart Disease | 6 | 4 |
| 10. | Malignant Disease | 6 | 4 |
| 11. | Smoker | 58 | 38.4 |
| 12. | Alcoholic | 41 | 27.2 |
| 13. | Stoma | 12 | 7.9 |
| 14. | SICU Admission | 56 | 37.1 |
| 15. | Mechanical Ventilation | 55 | 36.4 |

The most prevalent risk factors in descending order were hypoalbuminemia (85.4%), cigarette smoking (38.4%), SICU admission (37.1%), mechanical ventilation (36.4%), pulmonary disease (29.1%), and alcohol consumption (27.2%). that most of the subjects were underweight (53.6%) while 8.6% of them were obese. Only 37.7 % of the subjects had an acceptable body mass index.

Table 2: Distribution of risk factors between the suturing techniques

| No. of risk factors | Closure Technique | | | |
|---------------------|--------------------|------|-------------------|------|
| | Interrupted (N=40) | | Continuous (N=60) | |
| | No. | % | No. | % |
| None | 4 | 6.5 | 10 | 11.1 |
| 1 | 10 | 16.4 | 19 | 21.2 |
| 2 | 5 | 8.2 | 8 | 8.9 |
| 3 | 14 | 23.0 | 13 | 14.4 |
| 4 | 6 | 9.8 | 13 | 14.4 |
| 5 | 12 | 19.7 | 11 | 12.2 |
| >6 | 10 | 16.4 | 16 | 17.8 |

The above table demonstrates that the risk factors were evenly distributed between the two suturing techniques ($p=0.42$). Comparison of postoperative complications between the suturing techniques. In each of the complications studied, a higher percentage of complications were seen in subjects who underwent abdominal fascial closure using the continuous technique.

Table 3: Association of suturing technique with post-operative complications

| S.No | Complications | | Interrupted | | Continuous | | Chi-square |
|------|-------------------|-----|-------------|------|------------|------|------------|
| | | | (N=40) | | (N=60) | | |
| | | | No. | % | No. | % | |
| 1. | Wound infection | Yes | 12 | 19.7 | 22 | 24.4 | 0.47* |
| | | No | 49 | 80.3 | 68 | 75.6 | |
| 2. | Wound dehiscence | Yes | 5 | 8.2 | 14 | 15.6 | 1.79* |
| | | No | 56 | 91.8 | 76 | 84.4 | |
| 3. | Burst abdomen | Yes | 1 | 1.6 | 6 | 6.7 | 2.07* |
| | | No | 60 | 98.4 | 84 | 93.3 | |
| 4. | Incisional hernia | Yes | 5 | 8.2 | 10 | 11.1 | 0.34* |
| | | No | 56 | 91.8 | 80 | 88.9 | |

*($p > 0.05$)

The above table demonstrates that the complications observed with the continuous technique are higher than those with the interrupted technique. However, the difference is not statistically significant.

Table 4: Association of postoperative complications with the demographic variables

| S.NO | DEMOGRAPHIC VARIABLES | WOUND COMPLICATIONS | | | | | | | |
|------|-----------------------|---------------------|----|------------------|-----|---------------|-----|-------------------|-----|
| | | Wound infection | | Wound dehiscence | | Burst abdomen | | Incisional hernia | |
| | | Yes | No | Yes | No | Yes | No | Yes | No |
| | | | | | | | | | |
| 1. | Age: 15 – 30 years | 12 | 4 | 7 | 45 | 1 | 51 | 3 | 49 |
| | 31 – 45 years | 11 | 31 | 4 | 38 | 2 | 40 | 5 | 37 |
| | 46 – 60 years | 8 | 30 | 3 | 35 | 1 | 37 | 3 | 35 |
| | 61 – 90 years | 3 | 16 | 5 | 14 | 3 | 16 | 4 | 15 |
| | p-value | 0.83 | | 0.22 | | 0.08 | | 0.26 | |
| 2. | Gender: Male | 26 | 93 | 16 | 103 | 7 | 112 | 10 | 109 |
| | Female | 8 | 24 | 3 | 29 | 0 | 32 | 5 | 27 |
| | Chi – square | 0.14 | | 0.38 | | 1.97 | | 1.47 | |

There was no significant association between the increasing age of the subject or the gender with the development of wound complications ($p>0.05$). There was an association between anemia and the development of wound infection. There was an association between jaundice, renal failure, pulmonary disease, enteric fever, presence of a stoma, SICU admission, and mechanical ventilation with the development of wound dehiscence. There was an association between jaundice and pulmonary disease with the development of a burst abdomen. There was an association between pulmonary disease and mechanical ventilation with the development of incisional hernia. It was seen that wound complications were affected by preceding wound infection. It was found that 36.84% of subjects who developed wound dehiscence had a preceding wound infection ($p=0.110$). Forty-two point eight five percent of subjects who developed burst abdomen had a preceding wound infection ($p=0.187$). Thirty-one point eight one percent of the subjects who developed incisional hernia had a preceding wound infection ($p=0.018$); this was statistically significant.

DISCUSSION

Peritonitis is defined as inflammation of the peritoneum, which may be caused by pathogens or non-pathogenic factors, e.g., barium enema. Peritonitis is often synonymously used for intra-abdominal infection or intra-abdominal sepsis in the literature. The three most widely confused terms are contamination, infection, and sepsis.[8] Contamination means the presence of bacteria in normal sterile tissue without any host reaction. Infection is the presence of bacteria in normal sterile tissue with local host response (inflammation), clinically evident. Sepsis is the systemic response to local infection. Peritonitis may be caused by traumatic perforation of the bowel, anastomotic dehiscence, translocation of germs, inflammation, or perforation of a hollow viscus, e.g., appendicitis or colonic diverticulitis.[9] In this analysis of short-term results, we show that closing elective midline laparotomies using a short-stitch technique and an elastic suture material is a safe procedure with a low rate of short-term complications. The rate of burst abdomen did not differ significantly between treatment groups in the primary outcome analysis.[10] In multivariate analysis, however, short stitches were associated with a sevenfold decreased risk of developing a burst abdomen. This is the first study showing such a clear trend toward a reduced risk of burst abdomen; previous trials had shown no difference between suture techniques. The lack of more unanimous conclusions stems from the fact that the ESTOIH trial was not powered for the analysis of short-term wound complications. The overall rate of burst abdomen (3.1%) lies around the upper limit of the range anticipated from previous studies (e.g. PRIMA: 3.3%, INSECT 2.9%, PROUD: 2.6%, STITCH: 1.1%) probably reflecting the inclusion of many high-risk oncological surgeries in the present trial. In theory, suture material could be an alternative explanation, but this seems unlikely as there were more burst abdomens with the stronger suture.[11] Other outcomes related to wound healing, especially SSIs did not differ between treatment groups. It appears, hence, that if the stitch technique did influence the healing of the fascia, it did so directly and not primarily via a reduction of wound infections. The incidence of wound infection was 21%. [12] This comprises nearly a quarter of the patients in the study. Comparing the two techniques, 19.7% of the subjects closed by the interrupted technique developed postoperative wound infection as against 24.4%, where the continuous technique was utilized. These figures, although not statistically significant ($p > 0.05$), are certainly clinically significant. The incidence of wound dehiscence was 11%. [13] The incidence of wound dehiscence in the interrupted and continuous techniques was 9.09% and 15.6% respectively. This revealed nearly a double risk of developing wound dehiscence while closing the fascia with a continuous technique as compared to the interrupted technique. The possibility of the suture breaking or the knot cutting through tissue may be responsible for this difference, although documentary proof was unavailable. The incidence of burst abdomen was 3%. The interrupted technique recorded an incidence of 1.51% of burst abdomen, as against the 6.7% who developed it after closure with the continuous technique.[14] This association was clinically significant but not statistically significant. Burst abdomen is usually due to the suture cutting through the tissue. The study recorded the post-operative incidence of incisional hernia to be 10%. There was a 9.09% incidence of incisional hernia in the interrupted arm while there was an 11.1% incidence in the continuous arm.[15]

CONCLUSION

The best method of wound closure maintains tensile strength throughout the healing process with good tissue approximation, does not promote wound infection or inflammation, is well tolerated by patients, and is technically simple and expedient. Despite reports of the merits and the benefits of a continuous closure method, many surgeons are reluctant to abandon the time-tested interrupted wound closure technique using non-absorbable materials. This study aspires to observe and record wound complications after midline laparotomy incisions in the hope of spurring renewed interest in abdominal closure and possibly gathering evidence that warrants change in the current trend, or evidence encouraging the ongoing practice. The ideal method of abdominal wound closure has not been discovered. The ideal method should be technically so simple that the results are as good in the hands of the trainee as in those of the surgical master; it should be free from post-operative wound complications; it should be comfortable to the patient; and it should leave a reasonable aesthetic scar. The interrupted technique of abdominal fascial closure is advocated for decreasing both early and late postoperative wound complications in a contaminated wound. Various modifiable risk factors have been described to decrease the rate of development of post-operative wound complications.

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