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RESEARCH ARTICLE
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COMPARISON OF NON-INVAGINATION VERSUS INVAGINATION OF APPENDIX STUMP FOLLOWING APPENDECTOMY

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Abstract

Objective: To compare the efficacy of non-invagination versus invagination of appendix stump following appendectomy in terms of wound infection.

Study Design: Comparative Study.

Setting: Department of Surgery Shaheed Mohtarma Benazir Bhutto Medical University, Larkana, Pakistan.

Duration: Six months after the approval of synopsis from September 2020 to March 2021.

Materials and Methods : All patients who fulfilled the inclusion criteria and visited to SMBBMU, Larkana were included in the study. Informed consent was taken after explaining the procedure, risks and benefits of the study. The patients were randomly divided into two groups using computer-generated sequential number placed in sealed envelopes and opened only before the commencement of the study. In Group A after ligation and trans fixation, invagination of stump was done, while in group B only simple ligation and trans fixation of appendicular stump was done. Post-operative fever, vomiting if any and wound infection was noted. All the collected data were entered into the proforma attached at the end and used electronically for research purpose.

Results: Mean ±SD of age in group A was 29.3±6.3 and group B was 28.4±5.8 years. In group wise distribution of gender, 50 (57.4%) male and 37 (42.6%) females were enrolled in group A while 55 (63.2%) male and 32 (36.8%) females were included in group B. In comparison of efficacy, non-invagination was found to be effective in 05 (5.7%) while invagination was found to be effective in 14 (16.1%) patients after appendectomy and P value found to be significant i.e. (P=0.029).

Conclusion: It is to be concluded that significant difference was noted between non-invagination versus invagination in term of efficacy.

Key words: Efficacy, Invagination, Appendix Stump, Appendectomy, Wound Infection

INTRODUCTION

Acute appendicitis remains the most common abdominal surgical emergency in developed countries, most common in the second decade of life and affecting approximately 6-10% of the general population [1]. By adulthood one in six people will have undergone removal of their appendix. It may occur at any age but is most common in person between 20 and 40 years of age [2]. About 8% of people in Western countries have appendicitis at some time during their life, with a peak incidence between 10 and 30 years of age [3]. Lifetime risk of appendectomy 12% for men and 25% for women making it the most commonly performed operation in the world, with approximately 7% of all people undergoing appendectomy for acute appendicitis [4]. Appendectomy remains the standard treatment of acute appendicitis, which is performed by both open and laparoscopic approaches [5]. The length of the appendix varies from 2 to 20 cm, and the average length is 9 cm in adults [3]. The pathophysiology of acute appendicitis has long been thought to be the result of luminal obstruction by a fecalith, hyperplastic lymphoid tissue, parasitic infestation, or tumor, with subsequent localized venous ischemia resulting in mucosal disruption followed by invasive bacterial infection; viral ulceration may also be the cause of mucosal ulceration in certain patients [6]. Infection limited to the appendix itself results in localized inflammation and simple, or suppurative, appendicitis [7]. A number of clinical and laboratory-based scoring systems have been devised to assist diagnosis. The most widely used is the Alvarado (MANTRELS) score [8]. A score of 7 or more is strongly predictive of acute appendicitis [9]. In patients with an equivocal score, abdominal ultrasound or contrast-enhanced CT examination further reduces the rate of negative appendectomy [9]. Abdominal ultrasound examination is more useful in children and thin adults, particularly if gynaecological pathology is suspected, with a diagnostic accuracy in excess of 90% [10].

The technique of appendectomy has been reported to vary from institute to institute, from unit to unit, from surgeon to surgeon, starting from skin incision to the simple ligation, transfixation and invagination of appendicular stump, and so on. After ligation and transfixation of the appendicular stump some surgeon invaginate the stump by purse-string stitch or doubly invaginate the stump, while other advocate simple ligation and transfixation only, no invagination of the appendicular stump. Many surgeons believe invagination of the appendiceal stump is unnecessary [11].

A recent systematic review and meta-analysis found that in cases of open appendectomy, the patients with simple ligation had shorter hospitalization and operating time, a lower rate of paralytic ileus, and shorter temperature recovery time after surgery than those with stump invagination though stump invagination proved to be a better procedure in cases of laparoscopic surgery [12].

A study reporter wound infection (6% v/s 12%) among appendicitis. patients treated with non-invagination versus invagination of appendix stump respectively [13]. While another study reported the incidence of wound infection 2.3% in non-invagination v/s 4.6% in invagination of appendix stump in patients undergone appendectomy [14]. Stump burial after appendicectomy is a procedure frequently being performed by surgeons in the past but recently it is stated that this burial is associated with a rare complication of stump appendicitis which poses great difficulty in diagnosis and treatment [15]. Moreover, the invagination of stump results in mass appearance during contrast studies leading to diagnostic problems [16].

RATIONALE

Acute appendicitis is common in our part of the world and require prompt management. So current study is design to compare the efficacy of non-invagination versus invagination of appendix stump. To be best of our knowledge based on PubMed, Pak Medinet, Google Scholar, Medscape, Web of Science, Scopus and Cochrane library, no such study conducted last 5 years in our local population. Although the international literatures are available. Under the sub-optimal health care facilities, less health care awareness and late arrival of patients at the health care center, we expect variation in

results of our population as compare to that other part of the developed countries. The goal of this study is to provide an efficient and pragmatic surgical technique for surgical decision in order to reduce the complications. Therefore, this study is designed to figure out the current and concrete evidence regarding statistically significant difference between non-invagination versus invagination of appendix stump in terms of wound infection. Furthermore, strategies will be made to improve the outcome in such patients by adopting the superior approach as first choice of treatment in future.

OBJECTIVE

To compare the efficacy of non-invagination versus invagination of appendix stump following appendectomy in terms of wound infection.

OPERATIONAL DEFINITION

Wound infection: It was identified by clinical and subjective evidence of all of the following signs and symptoms:

Pain in the wound by history while redness, swelling and/or purulent discharge from the wound clinically, with or without fever (by thermometer, 100°F or more).

Yielding positive bacterial growth on culture in the laboratory**.**

Efficacy: It was determined in terms of wound infection. The procedure was considered effective if there was no wound infection within 14th day of post appendicectomy.

Null Hypothesis

There was no significant difference in efficacy of non-invagination versus invagination of appendix stump following appendectomy in terms of wound infection.

Alternate Hypothesis

There was a significant difference in efficacy of non-invagination versus invagination of appendix stump following appendectomy in terms of wound infection.

MATERIAL & METHODS :

STUDY DESIGN: Comparative Study

STUDY SETTING: Department of Surgery SMBBMU, Larkana.

DURATION OF STUDY: Six months after the approval of synopsis from September 2020 to March 2021.

SAMPLE SIZE

It was calculated by using W.H.O sample size calculator using incidence of wound infection (2.3%)[14] in non-invagination v/s (12%)[13] in invagination of appendix stump. Level of significance (α)=5%, Power of test (1-β) =
80%, then the estimated sample size was n=87 in each group.

SAMPLING TECHNIQUE

Non-Probability, Consecutive Sampling.

INCLUSION CRITERIA

Diagnosed patients of appendicitis between age group of 20---60 years, from either sex, or having no associated comorbid were included.

EXCLUSION CRITERIA

Patients with previous history of abdominal surgery, or perforated appendicitis were excluded from the study.

DATA COLLECTION

Data collection was started after approval of synopsis from Research department of CPSP. All admitted patients who fulfilled the inclusion criteria were included in the study. Informed consent was taken after explaining the procedure, risk and benefit of the study. Basic demographic information of each patient (name, age, sex) was noted. Once an eligible patient had been identified in the preoperative round meeting, the study details were carefully discussed with the potential subject and informed written consent was attained. The patients were randomly divided into two groups using computer-generated sequential number placed in sealed envelopes and opened only before the commencement of the study. The study was conducted in a single-blind fashion. In Group A after ligation and trans fixation, invagination of stump done by purse-string suture with vicryl 2-0 on a round body needle applied 1-2 cm away from the base of appendix, while in group B only simple ligation and trans fixation of appendicular stump were done. All surgery was carried out by Consultant General Surgery. Operative time was recorded in each case. It was taken from the start of incision to the last skin suture. None of the patients was required to put drain in abdominal cavity. Abdomen was closed in layers with vicryl 1-0 and skin with ethilon 2-0. Every patient was given only three doses of intravenous injection Ceftrioxone and metronidazole, first dose being the preoperative one. Postoperative fever, vomiting if any noted. Oral fluids were started after 12 to 24 hours, once patient passed flatus and bowel sounds was audible. All the patients were followed till 2 weeks in order to assess the efficacy in accordance with operational definition. All the collected information was noted and recorded in the proforma attached. Effect modifiers / confounding, explanatory variables and biasness were controlled by strictly following inclusion and exclusion criteria.

DATA ANALYSIS

Data was entered and analyzed by SPSS version 23.0. Mean±SD was calculated for age and duration of surgery. Frequency and percentage were calculated for gender and ASA status. Chi-square / Fisher's Exact test as appropriate was applied to compare the efficacy in both groups consider $P \leq 0.05$ as significant. Both groups were compared by age group, gender, duration of surgery and ASA status wise stratification by using Chi-square / Fisher's Exact test as appropriate test to see the impact of these on efficacy consider $P \leq 0.05$ as criteria of statistical significance. Result was presented in graph and table as appropriate.

RESULTS

In this comparative study, the total of 174 patients were divided in two groups. 87 patients were included in each group to compare the efficacy of non-invagination versus invagination of appendix stump following appendectomy in terms of wound infection and results were analyzed as:

Mean ± SD of age in group A was 29.3±6.3 with C.I (27.95----30.64) and group B was 28.4±5.8 with C.I (27.16----29.63) years.

Mean ± SD of duration of surgery in group A and group B was 35.2±6.6 and 33.5±6.1 with C.I (33.79----36.60) and (32.19----34.80) minutes.

In group wise distribution of gender, 50 (57.4%) male and 37 (42.6%) females were enrolled in group A while 55 (63.2%) male and 32 (36.8%) females were included in group B.

ASA-I was noted in 45 (46%) & 42 (54%) patients in groups A & B while ASA-II was noted in 48 (55.1%) & 39 (44.9%) in groups A & B.

In comparison of efficacy, non-invagination was found to be effective in 05 (5.7%) while invagination was effective in 14 (16.1%) patients after appendectomy and P value found to be significant i.e. (P=0.029), as shown in Table 1.

Stratification of age, gender, duration of surgery and ASA status was done with efficacy to assess the significant difference between both groups.

Table 1: COMPARISON OF EFFICACY BETWEEN GROUPS n=174

GROUP	EFFICACY		P-VALUE
	Yes	No	
GROUP A	5(5.7%)	82 (94.3%)	0.029
GROUP B	14 (16.1%)	73 (83.9%)	

Applied Chi-Square test

DISCUSSION

Acute appendicitis remains the most common abdominal surgical emergency in developed countries, most common in the second decade of life and affecting approximately 6-10% of the general population. By adulthood one in six people will have undergone removal of their appendix. It may occur at any age but is most common in person between 20 and 40 years of age [15-16]. About 8% of people in Western countries have appendicitis at some time during their life, with a peak incidence between 10 and 30 years of age [17]. Lifetime risk of appendicectomy 12% for men and 25% for women making it the most commonly performed operation in the world [18-19], with approximately 7% of all people undergoing appendectomy for acute appendicitis [19]. Appendicectomy remains the standard treatment of acute appendicitis, which is performed by both open and laparoscopic approaches [20]. The length of the appendix varies from 2 to 20 cm, and the average length is 9 cm in adults [17]. The pathophysiology of acute appendicitis has long been thought to be the result of luminal obstruction by a fecalith, hyperplastic lymphoid tissue, parasitic infestation, or tumor, with subsequent localized venous ischemia resulting in mucosal disruption followed by invasive bacterial infection; viral ulceration may also be the cause of mucosal ulceration in certain patients [21]. Infection limited to the appendix itself results in localized inflammation and simple, or suppurative, appendicitis.

The technique of appendicectomy has been reported to vary from institute to institute, from unit to unit, from surgeon to surgeon, starting from skin incision to the simple ligation, transfixation and invagination of appendicular stump, and so on. After ligation and transfixation of the appendicular stump some surgeon invaginate the stump by purse-string stitch or doubly invaginate the stump, while other advocate simple ligation and transfixation only, no invagination of the appendicular stump. Many surgeons believe invagination of the appendiceal stump is unnecessary [21].
The technique of appendicectomy has been reported to vary from surgeon to surgeon or from center to center, starting from skin incision to the ligation and invagination of appendicular stump, and so on. After ligation or transfixation of the appendicular stump some surgeons invaginate the stump by means of a purse-string stitch or a Z- stitch or doubly invaginate the stump while others advocate simple ligation without invagination of the appendicular stump [22]. Despite lack of evidence in many randomized clinical trials to justify the routine invagination of appendicular stump during appendectomy, many surgeons in many centers, including ours still advocate this technique of invagination of appendicular stump.

Invagination of appendicular stump during appendicectomy has traditionally been practiced by many surgeons in many centers despite lack of evidence from randomized clinical trials to justify its benefit [22-26].
The reasons given for this invagination of appendicular stump are safety against slipping of ligature from the stump or blow out of appendicular stump, less chances of peritonitis from spillage of pathogens from remaining the stump, less incidence of postoperative wound infection, better healing of gut by formation of granulation tissue and collagen from the serosal layer of caecum [27], on the other hand, who do simple ligation only found it simpler, less time consuming and leaving intact the anatomy of caecal wall [26], with no difference in the incidence of postoperative wound infection or paralytic ileus. However, there are reports of more residual abscesses over the wall of caecum due to

invagination of stump, besides the deformation (filling defect) may lead to the suspicion of a neoplasm [25,26]. Simple ligation of appendicular stump has been reported to obviate these misinterpretations [26]. In agreement with other randomized clinical studies [27-30]. Many studies suggest increased complications rate with appendicular stump invagination compared with simple ligation, stump invagination is sometime necessary when base of the appendix is inflamed [31,32].

Wound infection is most common postoperative complication associated with appendicectomy. In this study efficacy noticed in non-invagination (group A) as 05 (5.7%) and invagination (group B) as 14 (16.1%) after appendectomy and P value found to be significant i.e. (P=0.029). The reason of higher prevalence in group B can be attributed to stump burial with possible contamination of the needle going through the bowel lumen while taking the purse string suture around the base of the appendix [33-34]. This is comparable to other studies in which it was 5% [35], 7% [36] and 7.5% for the invagination group [37]. The wound infections were superficial and treated by opening the wound, draining the pus and sending it for culture and sensitivity. The patients were started with appropriate antibiotic for up to 7 days according to culture and sensitivity [38,39].

In our study, the mean age in group A was 29.3±6.3 and group B was 28.4±5.8 years. The study of Suvera MS, et al [1] stated mean age for group I as 28.36±5.5 and for group II as 27.11±4.9 years, Afridi NG, et al [13] reported a mean age of patients as 21.3 years whereas Chalya PL, et al [14] reported as 24.12±12.14 and 26.28±14.58 years for both groups. A study done by Haider J, et al [78] noted mean age of the patients included as 28.19±9.62 years. Another study reported mean age of 22.78±6.2 years [79].

The mean duration of surgery in group A and group B was 35.2±6.6 and 33.5±6.1 minutes. Suvera MS, et al [1] found duration of surgery as 46.36±5.2 and 37.26±5.4 minutes for both groups. Chalya PL, et al [14] noted duration as 30.6 and 45.3 minutes for group I and II, respectively. In this study, 50 (57.4%) males and 37 (42.6%) females were enrolled in group A while 55 (63.2%) males and 32 (36.8%) females were in group B. Suvera MS, et al [1] reported to have 23 (41.07%) males in group I and 24 (44.44%) males in group II and 33 (58.93%) females in group I and 30 (55.56%) females in group II. Afridi NG, et al [13] noted 37 (74%) male patients and 13 (26%) female patients in group A while in group B it was 34 (68%) and 16 (32%) respectively. The study of Chalya PL, et al [14] indicated that there were 20 (46.51%) males and 23 (53.49%) females in group I and 21 (47.72%) males and 23 (52.28%) females in group II. Haider J, et al [40] also reported to have 15 (71.4%) males and 06 (28.6%) females with a male to female ratio of 2.5:1. The study of Khan JS, et al [41] had 58% male and 42% female cases.

In present study, ASA status was classified as ASA-I was noted in 45(46%) & 42 (54%) patients in group A & B while ASA-II was noted for 48 (55.1%) & 39 (44.9%) in group A & B.
In recent study, stratification of confounders / effect modifiers with respect to efficacy, significant difference was noted in age group 20-30 as P=0.033 while insignificant difference was noted in other age group > 30 as P=0.270.

In this study, stratification of confounders / effect modifiers with respect to efficacy, insignificant difference was reported in male and female genders as P=0.053 and P=0.269, respectively.
In our study, stratification of confounders / effect modifiers with respect to efficacy, insignificant difference was found in duration group 20-30 as P=0.457 while significant difference was found in other duration group > 30 as P=0.036.

In present study, stratification of confounders / effect modifiers with respect to efficacy, insignificant difference was found in ASA-I group as
P=0.214 and ASA-II group as P=0.054.

CONCLUSION

It is to be concluded that significant difference was noted between noninvagination versus invagination in term of efficacy. More randomized clinical trials are necessary to evaluate the effectiveness of invagination and invagination probably with a larger sample size and with more parameters in multiple study centers in Pakistan are needed to validate the findings of the present study.

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