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Comparative Study of Irrigation with Povidone-Iodine Versus Normal Saline on Wound Infection After Open Appendectomy for prevention of Surgical Site Infection

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Abstract

Objective: Surgical site infections (SSIs) pose a continued problem to operating surgeons. It adds to the healthcare cost, increases morbidity and mortality and sometimes culminates in re-explorations. Rate of SSIs can be ameliorated by removing damaged or non-viable tissue, metabolic waste and wound exudates; this can be achieved by irrigation of surgical wound intra operatively. Surgical wound irrigation can also be performed postoperatively. Even after giving prophylactic antibiotics and august aseptic measures, post-appendectomy wound infection remains soaring. The efficacy of povidone-iodine on non-incised skin is well known but its application as an intraoperative irrigation solution in open surgical wounds is not a mundane practice. Likewise prophylactic irrigation with normal saline solution to prevent wound infection has also turned out to be effective in some studies. The objective of this study is to compare the percentage of superficial SSI post-appendectomy, with intraoperative irrigation of subcutaneous plane using 1% povidone-iodine solution versus normal saline.

Methods: 100 cases of open appendectomy for acute appendicitis at Medical College were randomly distributed into two arms. In group A, 0.9% Normal Saline was employed to irrigate subcutaneous tissue before skin closure while in group B irrigation with 1% diluted povidone-iodine solution was undertaken. The cases were assessed for infection in surgical wounds in line with Southampton wound grading system for five days after surgery and followed for thirty days.

Results: Mean age of participants of this study was 18.65 years. There were 50 patients in both groups and the groups were not different statistically in terms of age, gender and operative findings. A total of 19 (19%) out of 100 patients had Southampton grade 2 and above, signifying wound infection. Out of these, 15 (29%) were from Group A and 5 (9%) from Group B (p=0.001).

Conclusion: 1% diluted povidone-iodine irrigation of subcutaneous plane after appendectomy remarkably lowers the rate of SSI when compared with normal saline irrigation.

Keywords: Wound infection, appendectomy, povidone-iodine.

Introduction

Acute appendicitis is one of the most common surgical emergencies in the world with an annual incidence of 10 cases per 100,000 population [1]. While appendicitis complicated with mass or abscess is usually treated conservatively or with ultrasound-guided closed drainage, appendectomy remains the gold standard treatment for acute uncomplicated appendicitis [2]. Appendectomy can be performed by the traditional open approach or laparoscopically. Complications of appendectomy include surgical site infection (SSI), wound dehiscence, bowel obstruction, abdominal/pelvic abscess, and, stump appendicitis [3].

A recent study [4] revealed that open appendectomy had higher incidence of overall and incisional SSI than laparoscopic appendectomy (6.7% vs 4.5%), whereas the incidence of organ/space SSI in

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both groups was similar (3%). Another observational study [5] found higher rates of superficial SSI after open appendectomy (9%) as compared to laparoscopic appendectomy (5%).

Attempts have been made to reduce the incidence of SSI after appendectomy, one of which was intracavity and wound irrigation with various solutions. A recent Cochrane review [6] analyzed 59 randomized controlled trials on different types of surgical wounds, including clean, clean contaminated, and contaminated wounds. The trials assessed comparisons between irrigation and no irrigation and the irrigation groups comprised irrigation with different antibiotics, antiseptics, and non-antibacterial agents. The review concluded that the "evidence base for intracavity lavage and wound irrigation is generally of low certainty".

A large retrospective study [7] compared wound irrigation with antiseptic solution with normal saline in patients undergoing open appendectomy and concluded an evident superiority of antiseptic wound irrigation over normal saline.

The present trial aimed to assess the efficacy of layer-by-layer wound irrigation with povidone-iodine versus normal saline solution in prevention of incisional SSI after open appendectomy for acute appendicitis. There were two hypotheses for this trial which are: 1) wound irrigation with saline solution would decrease SSI rates; 2) adding povidone-iodine to the irrigation solution would further reduce SSI rates more than simple saline irrigation.

PatientsandMethods

This randomized controlled trial (RCT) was carried out from January 2019-22 in the Department of Surgery, Medical College and Hospital after approval of ethical review board.

The study included patients of either gender aged above 13 years who presented to the emergency department with acute appendicitis. Acute appendicitis was diagnosed by clinical examination and intraoperative findings and the diagnosis was confirmed by histopathologic examination of the removed appendix. We excluded patients with appendicular mass, appendicular abscess, appendicitis associated with generalized peritonitis, acute abdomen due to other causes as revealed intraoperatively, patients with normal appendix as revealed intraoperatively and after histopathologic examination, patients taking long course of steroid therapy or immunosuppressive treatment, and patients unwilling to participate in the trial.

Sample size was derived by keeping level of significance 5% and confidence interval 90% utilizing WHO calculator for sample size. Non-probability consecutive sampling approach was employed. A total of 200 patients both male and female, above 13 years of age, diagnosed on clinical grounds as acute appendicitis or registered for interval appendectomy, going for emergency or elective open appendectomy were included in this study. Patients below 13 years were ruled out of the study. Diabetic, uremic, jaundiced patients, individuals with rheumatoid arthritis, compromised immunity, cancer patients with chronic illnesses, bed bound patients, patients on certain drugs i.e. steroids and cytotoxic drugs, those undergoing radiation therapy and patients having generalized peritonitis were excluded. Moreover, finding a synchronous pathology other than appendicitis also ruled out inclusion to the research. Out of the 23 patients, which were excluded from this research, 13 patients had generalized peritonitis while 10 were diabetic. Informed and written consents were taken from all the participants of this research. Patients were randomly distributed into two arms; A (normal saline) and B (povidone iodine) with the help of computer-based randomization software (Research randomizer). To control bias, a uniform protocol was undertaken which had a 10 minutes scrubbing with 1% povidone-iodine, a skin crease incision i.e. Lanz, minimal tissue manipulation, use of identical suture material namely polyglactin suture for tying the mesoappendix and the base of appendix. Same suture was employed to close the peritoneum, muscle layers and the sheath, whereby new pair of gloves were worn after closure of fascia to carry out irrigation and skin closure with a running non-absorbable 2/0 polypropylene monofilament suture. Before inducing anaesthesia, a single dose of

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cephalosporin 2nd generation and metronidazole were injected. In group A, after closure of external oblique, wound was irrigated with 10 ml normal saline, while in group B the subcutaneous tissue was irrigated with 10 ml of 1% povidone-iodine solution. Both solutions were sprayed into the subcutaneous plane of the wound by a 10 ml syringe, left for 3 minutes before being mopped. Skin was closed with prolene 2/0 by subcuticle technique in all patients. Two further doses of 2nd generation cephalosporin along with metronidazole were infused intravenously in the postoperative period. Consultant surgeons (Assistant Professors & Senior Registrars) performed all operations. Postgraduate trainees, house officers and OT technicians assisted the procedures. Aseptic dry dressings were used to cover the surgical wounds in all participants, which were taken off on 2nd postoperative day by the primary surgeons prior to their discharge. All patients irrespective of group, had their surgical wounds evaluated on 5th postoperative day on their first follow up visit in the outpatient department for wound infection and followed on till the 30th post-operative day. The surgical wounds were graded in line with Southampton wound scoring system (Fig 1). Southampton grade 2 were marked to have wound infection. Primary surgeons managed all these patients with aseptic dressings on daily basis. Predesigned proforma was used to document information. It included demographic data, group of the patients, elective versus emergency procedures and examination findings of the surgical wounds indicating the suitable Southampton grade. Volume No. 24 (3), September 2019 Data analysis was done with SPSS version 19. Mean was calculated for age and frequencies were calculated for qualitative data like gender, Southampton wound grade. Chi square test was applied between proportions for significant difference. Significance was taken as $p < 0.05$.

Southampton Scoring System	
Grade	**Appearance**
0	Normal Healing
I Normal Healing with mild bruising or erythema	
A	Some Bruising
B	Considerable Bruising
C	Mild Erythema
II Erythema plus other signs of inflammation	
A	At one point
B	Around sutures
C	Along wound
D	Around wound
III Clear or Hemoserous discharge	
A	At one point only (<2 cm)
B	Along wound (>2 cm)
C	Large Volume
D	Prolonged (>3 days)
Major Complication IV plus:	
A	At one point only (<2 cm)
B	Along wound (>2 cm)
V Deep or severe wound infection with or without tissue breakdown; haematoma requiring aspiration	
The wound grading system used was simplified for the use of analysis. By using the worst wound score recorded and information about any treatment instituted either in hospital or the community, wounds were regarded in four categories:	

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(A) Normal healing
(B) Minor complications
(C) Wound infection – wounds graded IV or V or wounds treated with antibiotics after discharge from hospital, irrespective of the wound grading given to them by the nurse; and
(D) Major hematoma – wound or scrotal haematomas requiring aspiration or evacuation.

Figure 1. Southampton wound scoring system

Results

Out of 100 patients included in this study, 66 (66%) were male and 34 (34%) were female. Mean ± SD age of patients was 18.65 ± 4.76 years. Ages of patients ranged above 13 years (Table 1). The difference in mean age of patients in Group A (18.59 ± 4.84 years) and Group B (18.72 ± 4.70 years) was not statistically significant (p=0.848). There were 50 patients in both groups and no statistically significant difference was found between groups in gender distribution (Table 2). 5 of the total 100 patients were operated electively, while, the rest of 95 underwent emergency appendectomies. Out of the 5 elective operations, 3 were from group A, whereas, 2 were from group B. Operative findings were noted, 64 patients had no fluid around the appendix, 28 had serous fluid and 08 had purulent fluid locally. The groups were not different statistically in terms of operative findings (Table 3). The surgical wounds of patients in both groups were assessed on 5th post-operative day for SSI on the first follow up in outpatient clinic. The wounds were kept in continued follow-up until 30th post-operative day. 19 (19%) out of the 100 patients had Southampton grade 2 and above, signifying wound infection. All these patients had appendectomies in emergency. Out of these 29 (29%) were from Group A and 9 (9%) from Group B. Thus, the difference in wound infection incidence between Normal Saline irrigation group A and Povidone Iodine Irrigation Group B was statistically significant (p=0.001).

About 13 (12.5%) patients developed severe wound infection signified by serous or purulent discharge (Southampton wound grade 3 & 4), 21 were from Normal Saline irrigation group A and 4 were from group B. The difference between development of serous discharge (Southampton 3) and purulent discharge (Southampton grade 4) in appendectomy wounds amongst group A and B was statistically significant. None of the patients developed deep tissue infection (Southampton grade 5) (Table 4).

Discussion

Despite medical advances, SSI after appendectomy continues to be a major problem[2]. This research was undertaken to compare two substances (normal saline versus povidone-iodine) that may help in ameliorating the wound infection rate[5,9]. The overall frequency of wound infection (Southampton grade 2 or more) in our study was 19% (29% for normal saline group and 9% for povidone-iodine group) which is in conjunction to broad ranging post-appendectomy wound infection rate of 2.1 to 20% cited in national and international literature5,13. In studies conducted by S Patel and KS Sharma, though povidone iodine failed to slake SSI percentage but positively lowered the incidence of purulent discharge from wounds, thus ameliorated the severity of wound site infection[14,15]. Similarly, Chundamala J reviewed 15 studies, out of which 5 studies did not show povidone-iodine irrigation to be significantly more beneficial at preventing surgical site infection in comparison to normal saline, water or no irrigation. But the other 10 studies proved povidone-iodine irrigation to be significantly more beneficial in preventing surgical site infection when compared with normal saline, water or no fluid-irrigation[7]. The outcomes of these studies show a fruitful role of povidone-iodine irrigation in reducing surgical site infection when compared to irrigation with normal saline, which is in accord with the results of our study.

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Table 1. Sample Characteristics

	Mean Age +/- SD (Years)	Age Range (Min-Max)	Emergency Cases	Elective Cases
Group A	18.59 +/- 4.84	13-40	3 (3%)	97 (97%)
Group B	18.72 +/- 4.70	12-39	2 (2%)	98 (98%)
All Participants	18.65 +/- 4.76	12-40	95 (95%)	5 (2.5%)

Table 2. Gender Distribution

Gender	Total Patients n = 100 (%)	Group A n = 50 (%)	Group B n = 50 (%)	p-value
Female	34 (34%)	16 (32%)	17 (34%)	0.903
Male	76 (76%)	34 (68%)	33 (66%)	0.931

Normal saline is a frequently employed irrigation solution, owing to its isotonic nature and the fact that it does not interfere with wound healing[8]. Moreover, it is in common use to clear wounds from blood clots and nonviable tissue. Carlos and Cervantes studied syringe pressure irrigation of subcutaneous tissue with normal saline, and they inferred that the rate of postoperative SSI was remarkably slaked in complicated (perforated) cases by this particular intervention following appendectomy16. Shrikrishna Singh also came to the understanding that normal saline wound irrigation results in reduction in the incidence of postoperative SSI after appendectomy[17]. Meticulous irrigation with saline is an effectual method in patients having perforated appendicitis and wound infection as observed by GS Bhandari in his study[18]. In their work done at Sagar, Shah and his coresearchers found that 13.1% of open appendectomy patients had postoperative superficial wound infection19. However, lower infection rates were found in other studies. Gupta et al and Chaudhary et al in their respective studies observed wound infection in 5% and 6.4% of the study population respectively[20,21]. The causes for this variable proportion of SSI post-appendectomy is the inconsistent or non-specific definitions of superficial surgical site infection in these studies. In fact majority of the local researches discussed above were deprived of any definition or criteria to mark wound infection. This study applied Southampton wound grading system for grading the postoperative wound infection, which is a viable wound grading classification alongside ASEPSIS score and Centers for Disease control and Preventionn(CDC) classification and is employed by many authors globally[23].

Table 3. Operative Findings

OPERATIVE FINDINGS	Group A n = 50 (%)	Group B n = 50 (%)	p-Value
No fluid	32 (64)	32 (64)	0.929
Serous	14 (28)	15 (30)	0.789
Purulent	4 (8)	4.5 (9)	0.808

Comparison of wound infection after appendicectomy revealed that irrigation of povidone-iodine resulted in significantly lower SSI rate and incidence of Southampton grade 3 & 4 wound postoperatively (p-value <0.05)

In this study the povidone-iodine irrigation lessened the incidence of purulent discharge from operative site (p-value=0.030). The favourable outcome of povidone-iodine use was also reported by Harsh Khemani and co-workers in their study on 59 patients who were assigned into two groups randomly. One group was subjected to povidone-iodine gel application on the wound site before skin closure, whereas in the other group skin was closed without any application of povidone-iodine gel.

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Infection ensued in wounds of 18 patients, less in povidone-iodine gel group compared to control group i.e. 5 (16%) versus 13 (46%)

Table 4. Comparison of wound infection between normal saline versus povidone-iodine after appendectomy

Southampton Wound Grade	Total Patients n = 100 (%)	Group A Normal Saline Irrigation n = 50 (%)	Group B Povidone iodine irrigation n = 50 (%)	p-Value
Grade 0: Normal healing	65 (65)	25 (50)	34 (68)	0.082
Grade 1: Normal healing + mild Bruising	21 (21)	10 (10)	11 (22)	0.879
Grade 2: Erythema/ Tenderness/ heat	7 (7)	4 (8)	03 (6)	0.405
Grade 3: Serous Discharge	7 (7)	5 (10)	01 (2)	0.013
Grade 4: Purulent Discharge	6 (6)	5 (10)	01 (2)	0.021
Grade 5: Deep tissue infection	0 (0)	0 (0)	0 (0)	-

In a research having 200 clean cases both general and gynaecological, had one incident of wound infection in the 100 cases which had their wounds washed with normal saline whereas in the other arm with no intervention 8 incidents of wound infection were recorded. Staphylococcus aureus stood out to be the commonest organism while other notable organisms isolated were Streptococcus Pyogenes, Proteus, Klebsiella, E coli and Pseudomonas. MRSA was not detected[9]. Vinay and colleagues published the results of their study in 2019 which showed wound infection rate in povidone-iodine irrigation group (10%) while in normal saline irrigation group (7.8%)25. They concluded that infection rate did not change when the wound was irrigated with normal saline or povidone - iodine solution. However, they studied the irrigation on laparotomy wounds and their results are not in accordance with the outcomes of our study. Literature on both normal saline and povidoneiodine irrigation has varied results in terms of their effectiveness in preventing the surgical site infections. Our study ran a comparison of both solutions and found povidone-iodine more effective in preventing SSI after appendectomy than normal saline.

Conclusion

This study found that rate of SSI is significantly lowered after intraoperative irrigation of povidone-iodine versus normal saline irrigation. The occurrence of severe wound infection was also reduced in patients who had their wounds irrigated with povidone-iodine. Therefore, it is inferred that subcutaneous tissue irrigation with 1% diluted povidone-iodine after appendectomy remarkably reduces the surgical site infection rate in comparison to normal saline irrigation.

ConflictofInterest

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The authors of the study do not have any conflict of interest with findings of authors of previous studies.

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