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ORIGINAL ARTICLE

THE ROLE OF SINGLE DOSE ANTIBIOTIC PROPHYLAXIS IN OPEN MESH REPAIR OF INGUINAL HERNIA: A PROSPECTIVE, DOUBLE BLIND RANDOMIZED TRIAL

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ABSTRACT: OBJECTIVE: To assess the value of single-dose, intravenous, prophylactic antibiotic in the prevention of wound infections during tension free inguinal hernia mesh repair by a double-blind, prospective, randomized trial. **BACKGROUND:** Hernia repair is considered as one of the so-called 'clean' operations which may not require antibiotic coverage. Many surgeons, however, continue to give antibiotics empirically, as prophylaxis. This practice was more widely used after the establishment of the tension-free mesh repair technique as the method of choice for hernia repair, because of the fear of infection of the introduced foreign body. Several controlled randomised trials have been published on this topic, even before the introduction of the mesh repair techniques, however results are conflicting. **METHODS AND MATERIALS:** 200 patients were included in the study and the study population was randomized in two groups. The study group was administered parenteral cefazolin while the control group received placebo preoperatively. Follow up was done for 30 days post-surgery which included 180patients.The study was a double-blind randomized controlled trial, the results of which were analyzed statistically. **RESULT:** The overall infection rate was 8.3% (15 out of 180). The incidence of wound infection in antibiotic group was 7.4% and 9.3% in control group. There was no statistically significant difference in the infection rates between the two groups. **CONCLUSION:** Antibiotics showed a protective effect in preventing SSI after mesh inguinal hernia repair. However significant values cannot be obtained and cost effectiveness of antibiotic prophylaxis needs further evaluation. Therefore routine use is not recommended.
KEYWORDS: Inguinal hernia, prosthetic mesh, surgical site infection, antibiotic prophylaxis.

INTRODUCTION: The description of Lichtenstein tension free mesh repair introduced a new era in groin hernia repair.[1] It is one of the most common procedures performed by general surgeons. Inguinal hernia repair is the most commonly performed operation in the United States, owing to a significant lifetime incidence and variety of successful treatment modalities. It offers many advantages, such as simplicity, effectiveness, minimal pain, early return to work, low recurrence rates and a high patient satisfaction. It is currently considered as the preferred method for the plastic reconstruction of inguinal region. Inguinal hernia repair is one of the most common procedures performed by general surgeons. Even though hernia is classified as a clean surgery, the reported incidence of wound infection varies from 0% to 9%.[2]

The risk of wound infection increases after introduction of prosthetic material in the body, which is attributed to the detrimental effect of the prosthesis on the host defense mechanism.[3] The fear of infection of the prosthetic mesh raised the question of the potential role of antibiotic prophylaxis. It has been shown that administration of prophylactic antibiotics may inhibit the adherence of bacteria to the prosthesis and subsequently their growth rates.[4]

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In earlier studies, the first randomized control trial on the role of antibiotic prophylaxis in mesh repair of inguinal hernia was done in 2001 by Yerdel et al., who advocated the use of prophylactic antibiotics.[5] However, subsequent trials have produced varied results. A Cochrane meta-analysis on this topic in 2004 concluded that antibiotic prophylaxis in mesh repair of inguinal hernias can neither be recommended nor discarded.[6] This study was designed to evaluate the role of antibiotic prophylaxis in Lichtenstein repair of inguinal hernia. Moreover, it was intended to derive specific guidelines for antibiotic usage and to prevent their inadvertent use, which can prevent resistance and can have significant economic impact.

METHODS: The study was conducted in a tertiary care hospital (Victoria hospital, Bangalore Medical College) during a period of twenty months from June 2013 to Feb 2015 in the department of General surgery. All patients with primary unilateral or bilateral uncomplicated inguinal hernia who underwent elective mesh repair were included in our study. All patients between 15 years and 70 years of age with inguinal hernia were included in the study. Out of the 381 patients who underwent meshplasty during the study period, 181 patients were excluded as per the exclusion criteria given below:

1. Patients allergic to the given antibiotic.
2. Strangulated hernia or recurrent hernia.
3. Diabetes mellitus.
4. Pregnancy or lactation and with an immune compromised state like HIV, Malignancy or steroid medication.
5. Subjects on antibiotic within last 5 days for a different reason or existing indication for antibiotic prophylaxis (i.e. valvular heart disease).

Proper informed consent was obtained from all the patients entering into the study and their anonymity was maintained. The study was performed after the approval from hospital ethical committee. 200 patients were randomized into antibiotic group and control group by sealed envelope method on the day before the surgery. Patients in the antibiotic group received injection Cefazolin 1 g intravenously.20ml of normal saline was used as the placebo in the control group just before incision.

A standard Lichtenstein hernia repair was performed in all the cases. Monofilament polypropylene mesh (VYPRO™ Prolene Ethicon) was used as prosthesis. Povidone iodine was the antiseptic used for skin preparation in all patients. Groin shaving was done the day before surgery. A standard sterile dressing was applied post operatively. No post-operative antibiotics were used. Dressings were removed at 48 h after surgery, when the first wound inspection was done. No further dressings were applied. The patients were discharged next day with the advice of analgesics only. Surgeon who was not involved in surgery followed the case after 1 week and 4 weeks, postoperatively.

FOLLOW UP: Follow up consisted of noting history and clinical examination. In this study the major end point was to detect any differences between two groups in infectious complications.

The primary end point of the study was wound infection, defined by ASEPSIS criteria as:

- Purulent discharge (or serosanguinous with positive culture) or,
- Spreading erythema indicative of cellulitis or,
- Wound breakdown/dehiscence with clinical evidence of infection.

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The parameters studied included the following:

1. Patient proforma included demographic data including age, sex, co morbidity, direct/indirect hernia, duration of procedure.
2. Surgery related factors like type of anesthesia, antiseptic used for skin preparation, grade of surgeon, duration of surgery.
3. Incidence of surgical site infection.

The study was concluded in Feb 2015, by then, out of 200 patients who had entered the study, 180 patients had completed one month follow up.

All infectious complications were recorded and microorganism cultured/isolated from patients with wound infections was also recorded in the proforma.

STATISTICAL TOOLS: Statistical analysis was done using SPSS statistical software. The association between SSI and antibiotic status were analyzed using Fischer exact and chi square test. The effect of duration of surgery, hospital stay by unpaired t-test.

RESULTS: Among the 200 patients with one month follow up, 94 were in the antibiotic group and 86 were in the control group. Demographic data were comparable between the two groups. The data was analyzed using chi-square test.

The age of the patients in the study ranged from 15 years to 85 years. Mean age of the patients was 45, on applying chi-square test, the P value was 0.0569 (>0.05), which signifies that both the groups were comparable in terms of age distribution.

Out of total study population 179 were males (99.4%) and rest single patient was a female (0.5%). Both the study and control groups were comparable in terms of disease diagnosis and the age distribution. The results were analyzed using Fischer exact and chi square tests and these are tabulated in Table 1.

	Antibiotic group n (%)	**Control group n (%)**	**Total n (%)**	**p Value**
Age[a] (in years)	42.44 +/- 15.61	45.56 +/- 15.43	44.88 +/-15.99	0.569
Sex[b] Male Female	 93 (98.9%) 1 (1%)	 86 (100%) 0 (0%)	 179(99.4%) 1 (0.5%)	0.631
ASA grade[b] ASA I ASA II	 88(93.6%) 6(6.8%)	 80 (93%) 6 (6.9%)	 168 (93.3%) 12 (6.6%)	0.987
Co morbidity[b] Present Absent	 12(12.7%) 82(87.2%)	 4 (4.6%) 82 (95.3%)	 16 (8.8%) 164 (91.1%)	0.161
Type of hernia[b] Unilateral Bilateral	 90(95.7%) 4(4.2%)	 78(90.6%) 8(9.3%)	 168 (93.3%) 12 (6.6%)	0.003

Table 1

[a]Values expressed in mean standard deviation.

[b]Values expressed in numbers and percentage.

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The mean duration of surgery was 53minutes and was comparable in the study groups. The mean pre-operative hospital stay, mean post-operative stay as well as the total hospital stay was comparable in both the groups (Table 2).

Operative Data:

	Antibiotic group n (%)	**Control group n (%)**	**Total n (%)**	**p Value**
Preoperative stay (in days)[a]	3.9+/-3.33	4.1+/-2.07	4.15+/-2.91	0.287
Duration of[a] surgery (in minutes)	53.54 +/-15.82	52.60+/-15.28	53.06+/-15.56	0.612

Table 2

15 patients (8.3%) out of the total of 180 patients developed wound infection, out of which 7 patients belonged to the antibiotic group and 8 patients belonged to the control group. There was no statistically significant difference in the incidence of wound infection between the study groups, even though the number of infected patients was less in the antibiotic group (**p**=0.351) (Table 3).

Surgical Site Infection:

Infection	**Antibiotic Group n (%)**	**Control group n (%)**	**Total n (%)**	**P value**
Present	7(7.4%%)	8(9.3%)	15(8.3%)	0.351
Absent	87(92.5%)	78(90.6%)	165(91.6%)	0.351

Table 3

SSI was grouped as follows (Using CDC criteria):

- Superficial SSI: Wound cellulitis/erythema/purulent discharge from the wound.
- Deep SSI: Mesh infection.

No significant difference was found between the study groups on analyzing the sub types of infection.

Age, gender, ASA grade, co morbid illness, uni/bilateral hernia did not have any significant correlation with SSI rates.

The mean duration of surgery was 58.45 minutes in the group of infected patients when compared to 52.52 minutes in patients without infection, which was of borderline statistical significance (p=0.05). Patients with wound infection had a significantly longer preoperative hospital stay (p=0.035). The post-operative stay was similar in both groups. However, the total hospital stay was significantly longer in patients with wound infection

Correlation between operative variables and surgical site infection.

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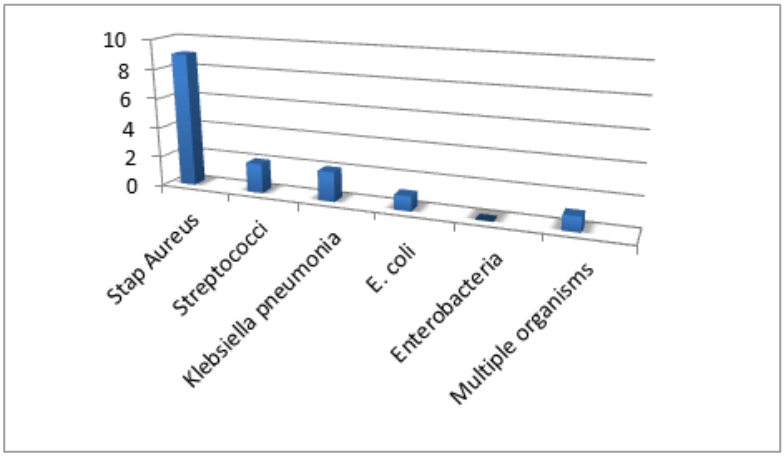
	Infected group	Uninfected group	p Value
Preoperative stay (in days)[a]	5.31+/-3.16	4.06+/-3.03	0.034
Duration of[a] surgery (in minutes)	58.45+/-17.45	52.52+/-15.28	0.05

The most common organism isolated was Staphylococcus aureus, which forms a part of normal skin flora. Staphylococcus is the most common isolate in surgical site infection following hernia repair in various studies.[5],[7],[8] Staph. Aureus was the organism isolated in 9 patients with culture positive infection. More than one organism was isolated in 3patients with culture positive infection.



Graph 1

DISCUSSION: Inguinal hernia repair has been traditionally considered as one of the so-called clean operations along with thyroid and breast surgery. It has been estimated that the postoperative wound infection should not be greater than 2%.[9],[10] The use of tension-free mesh repair techniques has become increasingly popular worldwide and considered as the method of choice for elective inguinal hernia repair. It constitutes approximately one-third of total surgical interventions.[11]

The incidence of surgical site infection following mesh repair of inguinal hernia has been ranging from 0% to 9%.[12] Such a wide range on SSI rates is due to the fact that studies differed in various aspects like difference in study design (retrospective, non-randomized vs. prospective, randomized), surveillance methods (surgical team vs. independent observer), definition of wound infection (no definition vs. CDC definitions), duration of follow-up, type of operation (mesh repair vs. non-mesh repair).[13]

The idea behind not using the antibiotics is to reduce the cost and to prevent the unnecessary use of antibiotics, thereby reducing the chance of antibiotics resistance. Occurrence of infection in postoperative period does increase the morbidity of the patient, may increase the hospital stay As well as return to work, and may require higher antibiotics. Most problematic scenario is the mesh getting infected, which may even require the removal of mesh.

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In our study, the overall infection rate was 8.3%, in patients undergoing elective mesh repair of primary inguinal hernias. The incidence of wound infection was 9.3% in the control group and 7.4% in the antibiotic group. Even though the incidence of wound infection was higher in the control group, it was not statistically significant (p=0.351).

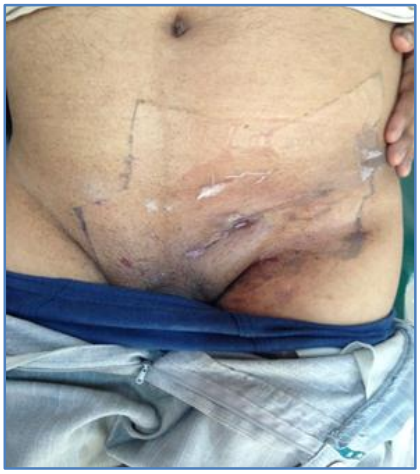

Fig. 1

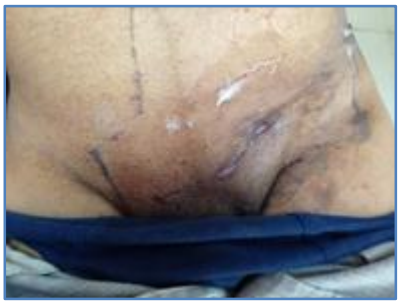

Fig. 2

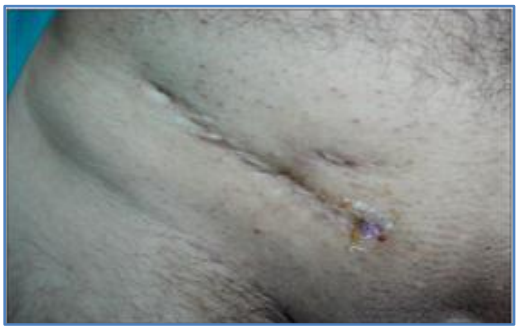

Fig. 3

The incidence of wound infection (8.3%) is higher in our study when compared to other studies. An Earlier study [13] done in our institute revealed a SSI rate of 8% in Inguinal hernias. There is no reliable data regarding the wound infection rates in the hospitals in the developing world and given the fact that few trials[5],[14] even in the developed world have reported 8 to 9% SSI rates, our trial may reflect the reality about SSI in developing countries.

There are conflicting reports in literature regarding role of prophylactic antibiotics for mesh hernioplasty. Earlier reports were conclusively in favor of antibiotic prophylaxis.[15],[5],[16],[17],[18] However, subsequently studies started questioning the practice of routine use of antibiotics.[8],[19],[20] Recent studies in Indian setting have consistently showed similar incidences of infection in the antibiotics prophylaxis group and control group.[21],[22],[23] However, in one of the studies the incidence of infection in the control group was quiet high.(10.5%).[21] In the recent Cochrane review, which evaluated patients of hernioplasty subgroup, showed that the antibiotic prophylaxis show a

significant reduction of wound infection rates. In that review it was concluded as: "In conclusion, the results of this meta-analysis show that antibiotic prophylaxis may be useful to prevent wound infection in open elective hernia repair. However, the data are not sufficiently strong neither to recommend its universal administration nor to recommend against its use when high rates of wound infections are observed."[24] Recently published two meta-analysis had shown the beneficial role of prophylactic antibiotics in reducing the infections.[25],[26] This study had infection rate which is acceptable for a clean operation. Antibiotics easily controlled infections that occurred. Mesh removal was not required in any of the cases. In our opinion there is strong case of avoiding antibiotics in elective mesh hernioplasty in patients with no risk factors. Further large studies and meta-analysis may prove that conclusively.

In our study, there is a positive correlation between the duration of pre-operative hospital stay and the development of post-operative SSI. The mean pre-operative hospital stay was 5.31±3.16 days in the patients with SSI in comparison to 4.06±3.03 days in patients without SSI. The difference was statistically significant (p=0.035). It is a well-known fact that increased preoperative hospital stay increased the risk of colonization with resistant bacteria.[27] Since we do not have day care facility; all our patients were operated as in patients, which is the reason for increased preoperative hospital stay in our study. We believe that this will be the case in majority of institutes in the developing world.

Only 2 (13.3%) out of 15 patients developed wound infection during their hospital stay, whereas the vast majority (86.6%) were diagnosed during follow up, most often during their first scheduled visit, in the 2nd post-operative week. In the study done by Perez et al.[15] on the role of antibiotic prophylaxis in mesh repair, all the infections were diagnosed after hospital discharge. This again emphasizes the need for follow up to establish the true incidence of SSI.

Vast majority of SSI occurring after hernia repair are superficial surgical site infection and are treated by simple drainage with or without antibiotics.[13] 93% of the SSI in our study was superficial SSI. All the SSIs reported in the studies done by Celdran et al.[14] and Tzovaras et al.[8]were superficial SSI. The incidence of mesh infection reported in literature varies from 0.35% to 1%.[5],[8],[28] The incidence of deep SSI was 0.6% in our study. Aufenacker et al.[19] reported an incidence of 0.3% for deep SSI in their study within a follow up period of 3 months. One patient had mesh removal due to SSI in our study.

Cefazolin was the antibiotic used in our study. It was chosen because of its proven efficacy against the common organisms like Staphylococcus aureus, longer duration of action and low cost.[29] Since majority of SSI in our study were due to Staph. aureus, the question of failure of prophylaxis due to inefficient antibiotic is ruled out. Cefazolin was the antibiotic used in studies done by Celdran et al., Morales et al., and Perez et al.[14],[30],[15] One gram of Cefazolinwas given intravenously at the time of induction of anesthesia. This is consistent with the studies done by other authors. The incidence of wound infection was 9% in the control group and 1% in the antibiotic group in the study done by Yerdel et al.[5] The authors showed a significant difference in wound infection between the antibiotic and control groups. Celdran et al.[14] reported SSI rates of 8% and 0% in the control and antibiotic group respectively and had similar conclusions.

Aufenacker et al.[19] showed that the incidence of SSI was 1.8% in the control group and 1.6% in the antibiotic group. The author concluded that prophylactic antibiotics did not prevent SSI in open mesh repair of inguinal hernias. The SSI rates reported by Perez et al.[15] were 3.3% and 1.7% in the

control and antibiotic group respectively and the author did not find any benefit with prophylactic antibiotics. A similar conclusion was drawn by Tzovaras et al.[8] where the incidence of SSI in control and antibiotic groups were 4.7% and 2.6% respectively. It should be noted that studies in which the rates of SSI are higher have reported that prophylactic antibiotics are beneficial, whereas similar conclusion could not be derived in the studies with low rates of SSI.

CONCLUSIONS: This study was designed to assess the efficacy of antibiotic prophylaxis in elective tension free mesh inguinal hernia repair in preventing the local infection. An almost equal rate of infection in both the study and the control groups was observed.

As a conclusion, we were not able to demonstrate any advantage of using antibiotic prophylaxis as a part of elective tension free mesh inguinal hernia repair. There was no significant difference in duration of hospital stay in both the groups. Therefore, this study does not recommend the use of antibiotic prophylaxis in elective tension free mesh inguinal hernia repair as it can prevent the development of bacterial resistance. Further, it can make the surgery for inguinal hernia much more economical and save a lot of revenue.

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