MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2024.9.637.642

OPEN ACCESS

Key Words
Antibiotics, ceftriaxone, single dose, surgical site infection

Corresponding Author
Yogesh K. Swami,
Department of General Surgery, Banas Medical College and Research Institute, Palanpur, Gujarat, India
drykswami@gmail.com

Author Designation
[1-3]Assistant professor
[4]Associate professor

Received: 10 August 2024
Accepted: 12 September 2024
Published: 17 September 2024

Citation: Ramkrishna Darji, Nikunj D. Bhesaniya, Sameer H. Marediya and Yogesh K. Swami, 2024. Impact of Prophylactic Antibiotic Regimens in Elective Hernia Surgery: Single-Dose vs. Multidose. Res. J. Med. Sci., 18: 637-642, doi: 10.36478/makrjms. 2024.9.637.642

Impact of Prophylactic Antibiotic Regimens in Elective Hernia Surgery: Single-Dose vs. Multidose

[1]Ramkrishna Darji, [2]Nikunj D. Bhesaniya, [3]Sameer H. Marediya and [4]Yogesh K. Swami

[1,3,4]Department of General Surgery, Banas Medical College and Research Institute, Palanpur, Gujarat, India
[2]Department of General Surgery, Shantaba Medical College and General Hospital, Amreli, Gujarat, India

ABSTRACT
Surgical site infections (SSIs) in elective hernia surgeries pose significant postoperative challenges. This study investigates the impact of single-dose versus multidose antibiotic prophylaxis on the incidence of SSIs and related complications, specifically in inguinal hernia repairs. A total of 100 patients undergoing elective groin surgery were randomly assigned to either a single-dose (SD) or multiple-dose (MD) antibiotic regimen group. Both groups received ceftriaxone 1g intravenously, with the MD group continuing the antibiotic postoperatively. Surgical outcomes, including SSI rates, were monitored and analyzed. Of the 100 patients, 5 developed SSIs, with 4 in the SD group and 1 in the MD group. The difference in infection rates between the groups was not statistically significant. Staphylococcus was the most common microorganism isolated. Complications were minor and similar across both groups. A single-dose antibiotic regimen is effective and cost-efficient for SSI prevention in elective hernia surgeries, reducing the risks associated with prolonged antibiotic use.

INTRODUCTION

Surgical site infections (SSIs) are a critical concern in postoperative care, often leading to prolonged hospital stays, increased healthcare costs and elevated morbidity and mortality rates, particularly in rural areas[1]. SSI are associated with increased morbidity as well as mortality due to high risk of complications including need for revision surgery, prolonged hospitalization, reduced work capacity and productivity, poor quality of life and need for antibiotic therapy., sequel include revision surgeries, poor quality of life, prolonged antibiotic treatment etc[2]. Effective prevention of SSIs relies heavily on antimicrobial prophylaxis, along with other factors like proper operation theatre sterilization, surgical expertise, and patient preparation[3]. However, the overuse of antibiotics, driven by the fear of infection, can lead to significant financial burdens and the development of antibiotic-resistant organisms. Ceftriaxone is widely regarded as a safe and effective prophylactic antibiotic due to its broad-spectrum efficacy and favourable safety profile. This study seeks to compare the outcomes of single-dose versus multiple-dose antibiotic regimens in elective hernia repairs, specifically focusing on the incidence of SSIs and related complications.

Inguinal hernias, which represent the majority of abdominal wall hernias, are frequently treated with mesh hernioplasty-a procedure known for its low recurrence rates. Although these surgeries are classified as clean with a low risk of SSIs, infections can still occur, warranting the need for effective prophylactic measures[4,5,6]. This study aims to explore the impact of antibiotic prophylaxis on SSI rates in hernia surgeries, considering variables such as the duration of the surgery and individual patient characteristics.

SSIs are among the most common healthcare-associated infections, especially in developing countries, where they contribute to severe complications, including the necessity for revision surgeries and extended hospitalizations. Preventive strategies, such as rigorous sterilization practices and the use of prophylactic antibiotics, are crucial, though the prolonged use of antibiotics raises concerns about antimicrobial resistance[7]. Clinical guidelines emphasize the need for the rational use of antibiotics, with evidence suggesting that a single preoperative dose may be sufficient for preventing SSIs.

However, research in the Indian context remains limited. This study aims to assess the efficacy of single-dose versus multidose antibiotic prophylaxis in clean elective surgeries, with the goal of determining the most effective approach for SSI prevention.

MATERIALS AND METHOD

This study included 100 eligible patients who were admitted for elective groin surgery. The patients were randomly assigned to one of two groups, each consisting of 50 individuals: a single-dose pre-operative (SD) group and a multiple-dose (MD) group. Participants who consented to the study were randomly allocated into the groups using simple random sampling. Detailed information was collected and recorded for each patient, including sociodemographic variables, medical history, complaints, diagnosis and any coexisting conditions.

Inclusion Criteria:

- Age between 18 and 55 years.
- Willingness to provide consent.
- Diagnosis of inguinal hernia.

Exclusion Criteria:

- Lack of consent.
- Age below 18 years.
- Recurrent, incarcerated, strangulated, bilateral, or femoral hernias.
- Diabetic patients.
- Patients with liver or renal impairment.
- Patients on steroid medication.
- Patients with antibiotic allergies.
- Patients who received antibiotics <a week before surgery.
- Patients with compromised immune systems.
- Patients with local skin infections or disease at the incision site.

Randomization: The patients were divided into two groups of 50 each through simple random sampling.

- **Group I:** Single-dose group received a single dose of ceftriaxone 1g intravenously at the time of anesthesia induction.
- **Group II:** Multiple-dose group received ceftriaxone 1g intravenously at anesthesia induction and twice daily for two days postoperatively.

All patients underwent a standard Lichtenstein hernia repair. Preoperative skin preparation was performed with Povidone-iodine and groins were shaved the day before surgery. Post-surgery, a sterile dressing was applied and no further antibiotics were given to the study group. Wounds were inspected 48 hours post-surgery and dressings were removed, with no further dressings applied. Follow-up was conducted by non-operating surgeons on the 7th day and one month post-surgery.

Infection development within one month was assessed based on criteria such as pus discharge, microorganism isolation from the incision, or culture-positive

superficial incision with signs of infection. Infections were managed with dressings and if necessary, sutures were removed for drainage. If infections worsened, antibiotics were administered. The study results focused on evaluating superficial and deep surgical site infections (SSI).

Statistical Analysis: Data were analyzed quantitatively for mean and standard deviation, including preoperative antibiotic usage and wound site infection rates. The Chi-square test was used to identify significant associations between the groups, with a $p<0.05$ considered statistically significant.

RESULTS AND DISCUSSIONS

Patients undergoing elective surgery for uncomplicated inguinal hernia were selected for inclusion in this study. Information was meticulously gathered on surgical site infections, duration of hospitalization, and related costs, followed by thorough organization and analysis. Only those individuals who fully satisfied the inclusion criteria and were comparable across all relevant factors were included in the research. Data was collected from two groups. Group I, consisting of 50 patients receiving a single-dose antibiotic regimen, and Group II, comprising 50 patients on a multidose antibiotic regimen. Both groups underwent elective hernia surgery.

Table 1: Patients' Demographic Data.

		Group I	Group II	Total
Mean Age (Years)		36.22	37.89	18 to 55 years
Site	Right	29	27	56
	Left	21	23	44
Type	Direct	39	34	73
	indirect	11	16	27

The patients in both groups were compared on basis of baseline characteristics including age, gender, type and side of the hernia. The average age was 36.22 years and 37.89 years in the group I and group II respectively, with the range of patients being from 18 to 55 years. Out of 50 patients in the group I, 29 patients (58.0%) had a hernia on the right side and 21 patients (42.0%) had a hernia on the left side. In the group II (50 patients), 27 patients (54%) had a hernia on the right side while patients (46%) had a hernia on the left side. With regards to the type of hernia, 39 patients (78.0%) had a direct hernia and 11 patients (22%) had an indirect hernia in the group I. In the group II, 34 patients (68%) had direct hernia and 16 patients (32%) had an indirect hernia. A total of 73 patients (73%) and 27 patients (27%) had direct and indirect hernias respectively. The patients' demographic data are shown in Table-I.

Table 2: Surgical Site Infection.

Infection	Group I	Group II	Total
Present	4	1	5
Absent	46	49	95
Cellulites	2	1	3
Mesh infection	1	0	1
Pus discharge	1	0	1

Out of the 100 patients, 5 (5%) developed wound infections. Among these, 4 patients were from Group I, while only 1 patient was from Group II. Although the number of infections was lower in Group II, the difference in infection rates between the two groups was not statistically significant (Table 2).

SSI was Grouped as Follows (Using CDC Criteria):
Superficial SSI: Wound cellulites/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.

Table 3: Correlation Between Operative Variables and Surgical Site Infection.

Variable	Infected	Uninfected
Duration of surgery in minutes	52.5±17.45	46.34±13.48
Pre-operative hospital stay	5.04±2.36	4.14±3.09
Post operative hospital stay	4.06±3.18	2.67±1.36
Total hospital stays	9.1±5.54	6.81±4.45

Surgery related factors duration of surgery was analyzed and were comparable in the two groups. The mean duration of surgery was 49 minutes 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 3).

Table 4: Isolated Microorganisms Cultured in Patients with Infections.

Microorganism	Total
Staphylococcus	3
Streptococcus	1
Klebsiella	1

The wound sites were tested for microorganisms, revealing that among the five patients with wound infections, three were found to have Staphylococcus infections, one had a Streptococcus infection and one was infected with Klebsiella. All patients diagnosed with Streptococcus were re-evaluated one month after discharge to check for any secondary infections.

Table 5: Complications in Patients of Both Groups.

Complications	Group I	Group II
Urinary retention	2	1
Hydrocele	1	0
Seroma formation	1	1
Orchitis	0	0

Both the groups were also analyzed for any postoperative complications. Two patients in the group

I and one patient in group II developed urinary retention after the surgery. The patient were catheterized and discharged. De-catheterization was successfully done at the time of suture removal. One patient in the group I was also diagnosed with hydrocele and was treated conservatively till 1-month post-surgery. The patient was analyzed 30 days after the discharge and was advised to visit again for hydrocele surgery after six months but he did not join the follow-up. One patient in each group were diagnosed with seroma and treated conservatively. The complication rate of both groups was statistically insignificant (p>0.05).

Antibiotic prophylaxis remains recommended for elective surgeries involving prosthesis implantation, as the risk of infection, though potentially severe, warrants precaution. However, the necessity of antibiotic prophylaxis in elective procedures like inguinal hernia repair is still a topic of debate[8]. The extremely low incidence of wound infections and the high quality of surgical management are often cited as reasons against the routine use of antibiotic prophylaxis in inguinal hernia repair[9]. The reported incidence of surgical site infections (SSIs) following mesh repair of inguinal hernias varies widely, ranging from 0%-9%[10]. This significant variation in SSI rates can be attributed to differences in study design (retrospective and non-randomized versus prospective and randomized), surveillance methods (surgical team versus independent observer), definitions of wound infection (lack of a standard definition versus CDC definitions), follow-up duration and the type of surgery performed (mesh repair versus non-mesh repair)[11].

A Cochrane meta-analysis conducted in 2004 examined the prophylactic use of antibiotics, but the findings were inconclusive regarding their effectiveness. Given that inguinal hernia repair is one of the most commonly performed surgeries worldwide, both the misuse of antibiotics and the occurrence of surgical site infections result in significant medical and social costs. Thus, it is crucial to establish clear evidence on the appropriate use of antibiotics in such procedures[12,13]. Critics of antibiotic use contend that patients undergoing Lichtenstein hernia repair still experience infections despite receiving antibiotics and excessive use of these drugs can contribute to antibiotic resistance. Additionally, there is concern that patients might face severe allergic reactions and the frequent use of antibiotics in this procedure could place a significant financial burden on the healthcare system. Conversely, an infection following mesh repair can increase the likelihood of recurrence by four times and may necessitate drainage and removal of the mesh. This suggests that while the mesh itself does not inherently pose an infection risk, when an infection does occur, it tends to be severe[14].

Our study found a wound infection rate of 5%, which is higher than reported in other studies. An earlier investigation conducted at other institution showed a surgical site infection (SSI) rate of 8% for inguinal hernias. There is limited reliable data on wound infection rates in hospitals within the developing world and only a few trials have addressed this issue[15,16]. Tzovaras *et al.* conducted a study to assess the effectiveness of antibiotic prophylaxis in elective open inguinal hernia repair with a prosthetic mesh. Their findings indicated that antibiotic prophylaxis did not provide significant benefits for this procedure[17]. Similarly, a randomized prospective study by Al-Fatah[18] reached the same conclusion. In contrast, Ullah[19]. studied 166 patients, splitting them into antibiotic and placebo groups and found that antibiotic prophylaxis was more effective for mesh plasty. Various studies have explored the efficacy of antibiotic prophylaxis in elective hernia repair, but results differ due to variations in study conditions. In Yerdel[20].'s study, the infection rate was 9% in the control group compared to 0.7% in the antibiotic group. Similarly, research by Celdran[16] and Usang *et al.* also found that the incidence of surgical site infections (SSI) was higher in the control group than in the antibiotic group.

Our study found a positive correlation between the length of pre-operative hospital stay and the likelihood of developing post-operative surgical site infections (SSI). Patients with SSI had an average pre-operative hospital stay of 5.04±2.36 days, compared to 4.14±3.09 days for those without SSI. This difference was statistically significant (p=0.035). It is well-established that a longer pre-operative hospital stay increases the risk of colonization by resistant bacteria[21]. Since we do not have a day care facility, all our patients were admitted as inpatients, leading to longer pre-operative stays in our study. We believe this scenario is common in many institutions in the developing world.

Tzovaras[17], Aufenacker[22] and Perez[23] found in their studies that prophylactic antibiotics did not prevent surgical site infections (SSI) following inguinal mesh repair. In our study, 80% of patients developed superficial SSI. Similarly, research by Tzovaras *et al.,* Celdran *et al.,* Ergul *et al* and Jain *et al.* also reported that all SSIs were superficial[14,16,17,24]. Research indicates that the incidence of mesh infection ranges from 0.35%-1%. In our study, one patient experienced deep surgical site infections (SSI) that required mesh removal. However in the studies by, Aufenacker[22] and Othman[25] reported no cases of mesh removal. In the studies by Perez[23] Shankar[26] and Yerdel[15] a few patients had mesh removal. one patient in each of

Perez[23] and Shankar[26] and three patients in the placebo group of Yerdel[15] with deep SSI.

CONCLUSION

In conclusion, Our research compared single-dose versus multiple-dose antibiotic prophylaxis for hernia repair, revealing that the infection rates were similar between the two regimens. This indicates that a single-dose regimen is as effective as multiple doses and is more cost-effective for uncomplicated elective surgeries. Additionally, single-dose prophylaxis helps avoid the higher costs and risks associated with long-term antibiotic use, including antibiotic resistance. Therefore, incorporating a single-dose regimen into routine practice could reduce SSI risks and alleviate unnecessary financial burdens. Further evaluation is needed to confirm the overall cost-effectiveness of antibiotic prophylaxis in such settings.

REFERENCES

1. Isik, O., E. Kaya, H.Z. Dundar and P. Sarkut, 2015. Surgical Site Infection: Re-assessment of the Risk Factors. Chirurgia, 110: 457-461.
2. Kirby, J.P. and J.E. Mazuski, 2009. Prevention of surgical site infection. Surg Clin North Am., 89: 365-389.
3. Anchez, M.F.J. and G.J.L. Seco, 2004. Antibiotic prophylaxis for hernia repair. Cochrane Database Syst Rev., Vol. 4.
4. Dahlberg, K., A. Philipsson, L. Hagberg, M. Jaensson, M.N. Hälleberg, and U. Nilsson, 2017. Cost-effectiveness of a systematic e-assessed follow-up of postoperative recovery after day surgery: A multicentre randomized trial. Br. J. Anaesth., 119: 1039-1046.
5. Huerta, S., C. Timmerman, M. Argo, J. Favela and T. Pham et al., 2019. Open, laparoscopic, and robotic inguinal hernia repair: Outcomes and predictors of complications. J. Surg. Res., 241: 119-127.
6. Al-Azzam, S.I., K.H. Alzoubi, N.M. Mhaidat, R.D. Haddadin and M.M. Masadeh et al., 2012. Preoperative antibiotic prophylaxis practice and guideline adherence in Jordan: A multi-centre study in Jordanian hospitals. J. Infec. Dev. Ctries., 6: 715-720.
7. Bratzler, D.W., E.P. Dellinger, K.M. Olsen, T.M. Perl and P.G. Auwaerter et al., 2013. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am. J. Health. Syst. Pharm., 70: 195-283.
8. Bendavid, R., 1998. Complications of groin hernia surgery. Surg Clin North Am., 78: 1089-1103.
9. Law, D.J., S.F. Mishriki and P.J. Jeffery, 1990. 1. The importance of surveillance after discharge from hospital in the diagnosis of postoperative wound infection. Ann R Coll Surg Engl., Vol. 72, No. 3.
10. Terzi, C., 2006. 1. Antimicrobial prophylaxis in clean surgery with special focus on inguinal hernia repair with mesh. J Hosp Infect., Vol. 62, No. 4.
11. Sanchez, M.F. and J.G. Seco, 2010. Antibiotic prophylaxis for hernia repair.. Coch Data Syst. Rev., Vol. 2012, No. 2 .10.1002/14651858.cd003769.
12. Orelio, C.C., C. van Hessen, F.J.M. Sanchez, T.J. Aufenacker and R.J. Scholten, 2020. Antibiotic prophylaxis for prevention of postoperative wound infection in adults undergoing open elective inguinal or femoral hernia repair. Coch Data Syst. Rev., Vol. 4, No. 4 .10.1002/14651858.cd003769.pub5.
13. Jain, S.K., T. Hameed, D. Jain, M. Singh and A. Nizam, 2021. The role of antibiotic prophylaxis in lichtenstein repair of primary inguinal hernia: A prospective double-blind randomized placebo-controlled trial. Niger J Surg., 27: 5-8.
14. Yerdel, M.A., E.B. Akin, S. Dolalan, A.G. Turkcapar, M. Pehlivan, I.E. Gecim and E. Kuterdem, 2001. Effect of single-dose prophylactic ampicillin and sulbactam on wound infection after tension-free inguinal hernia repair with polypropylene mesh. Ann. Surg., 233: 26-33.
15. Celdrán, A., O. Frieyro, J.C.D. Pinta, J.L. Souto, J. Esteban, J.M. Rubio and J.F. Señarís, 2004. The role of antibiotic prophylaxis on wound infection after mesh hernia repair under local anesthesia on an ambulatory basis. Hernia, Vol. 8 .10.1007/s10029-003-0164-7.
16. Tzovaras, G., S. Delikoukos, G. Christodoulides, M. Spyridakis and F. Mantzos et al., 2007. The role of antibiotic prophylaxis in elective tension-free mesh inguinal hernia repair: Results of a single-centre prospective randomised trial. Int. J. Clin. Pract., 61: 236-239.
17. Abd Al, F.M., 2011. 1. The role of antibiotic prophylaxis in prevention of wound infection after lichtenstein repair of primary inguinal hernia. Al-Azhar Assiut Med J., 9: 173-180.
18. Ullah, B., S.A. Khan, S. Ahmed and T. Pasha, 2013. 1. Efficacy of preoperative single dose antibiotic in patients undergoing mesh repair for inguinal hernia. J Ayub Med Coll Abbot., 25: 103-105.
19. Usang, U.E., O.A. Sowande, O. Adejuyigbe, T.I.B. Bakare and O.A. Ademuyiwa, 2008. The role of preoperative antibiotics in the prevention of wound infection after day case surgery for inguinal hernia in children in ile ife, Nigeria. Pediatr. Surg. Int., 24: 1181-1185.

20. Garibaldi, R.A., D. Cushing and T. Lerer, 1991. Risk factors for post operative infection. Am J Med., Vol. 91, No. 3.
21. Aufenacker, T.J., M.J.W. Koelemay, D.J. Gouma and M.P. Simons, 2006. Systematic review and meta-analysis of the effectiveness of antibiotic prophylaxis in prevention of wound infection after mesh repair of abdominal wall hernia. Br. J. Surg., 93: 5-10.
22. Perez, A.R., M.F. Roxas and S.S. Hilvano, 2005. A randomized, double-blind, placebo-controlled trial to determine effectiveness of antibiotic prophylaxis for tension-free mesh herniorrhaphy. J. Am. Coll. Surgeons, 200: 393-397.
23. Ergul, Z., M. Akinci, C. Ugurlu, H. Kulacoglu and K.B. Yilmaz, 2012. Prophylactic antibiotic use in elective inguinal hernioplasty in a trauma center. Hernia, 16: 145-151.
24. Othman, I., 2011. Prospective randomized evaluation of prophylactic antibiotic usage in patients undergoing tension free inguinal hernioplasty. Hernia, 15: 309-313.
25. Shankar, V.G., K. Srinivasan, S.C. Sistla and S. Jagdish, 2010. Prophylactic antibiotics in open mesh repair of inguinal hernia-a randomized controlled trial. Int. J. Surg., 8: 444-447.