



# Meta-Analysis on the effectiveness of the Use of Prophylactic Antibiotics in Preventing Surgical Site Infection in Patients with Hernia Surgery

Heru Wijono<sup>1</sup>, Febryza Kristin<sup>2</sup>, Beryl Bayanaka Agustha Peerera<sup>3</sup>, Fauna

Herawati<sup>2</sup>, Rika Yulia<sup>2\*</sup>

<sup>1</sup> Doctoral Program, Faculty of Public Health, University of Airlangga, Jalan Dr. Ir. H. Soekarno, Mulyorejo, Kec. Mulyorejo, Surabaya 60115, Indonesia

<sup>2</sup> Faculty of Pharmacy, University of Surabaya, Jalan Raya Kalirungkut, Surabaya 60293, Indonesia

<sup>3</sup> National Hospital; Jl. Lontar Indah VII Blok PA 11 No. 58, Lontar, Kec. Sambikerep, Surabaya 60216, Indonesia

\*Corresponding author. Email: rika\_y@staff.ubaya.ac.id

## ABSTRACT

The administration of prophylactic antibiotics in hernia surgery patients is currently controversial, with varying opinions regarding their necessity. The European Hernia Society guideline does not recommend prophylactic antibiotics in patients with hernia surgery, while recent studies found that prophylactic antibiotics in hernia surgery patients can be given routinely and are effective in reducing surgical site infections. This study aims to determine the effectiveness of prophylactic antibiotics for preventing surgical site infection in patients with hernia surgery. This research is a systematic review using articles with a randomized controlled trial (RCT) research design using Indonesia and English language within the last 10-year of publication year. Twenty-four RCTs that met the inclusion and exclusion criteria were used to address the research problem. The results showed that a total of 207 patients experienced the incidence of surgical site infection in patients with hernia surgery, including 78 patients (4.5%) in the antibiotic group and 129 patients (7.88%) in the control. A significant difference was found between the antibiotic and the control groups in preventing surgical site infections, with a P-value < 0.0001 (OR = 0.56; 95% CI = 0.42–0.75). Conclusion: Surgical site infections are less likely to develop when a prophylactic antibiotic is administered to patients with hernia surgery

**Keywords:** prophylactic antibiotics, surgical site infection, hernia surgery

## 1. INTRODUCTION

Surgical Site Infection (SSI) is one of the complications associated with the surgical process. It commonly occurs within 30 days in the area of the surgical incision after the surgical procedure. According to data from the National Nosocomial Infections Surveillance (NNIS) [1], surgical site infection is the third most frequently reported nosocomial infection, accounting for 14% to 16% of all nosocomial infections among inpatients and 38% among surgical patients. The occurrence of surgical site infections has the potential to increase morbidity, mortality, costs, and the duration of patient hospitalization [2].

One of the health problems that require surgical intervention is a hernia. It is estimated that over 20 million operations on hernias worldwide are done every year [3]. Hernia surgery is classified as a clean surgical procedure in the digestive surgery category and is almost always an elective procedure performed under sterile conditions. However, surgical site infection complications can still occur in hernia surgeries, even with clean surgical techniques [4]. Based on a prospective study by Juvany [5], out of a total of 101 patients who underwent hernia surgery, 16 patients (16%) experienced surgical site infections.

Prophylactic antibiotics are commonly used to prevent or reduce the occurrence of surgical site infections during surgical procedures. However, the use

of prophylactic antibiotics in hernia surgery is still a subject of controversy. The European Hernia Society guidelines [6] do not recommend the use of prophylactic antibiotics in hernia surgery, while a previous systematic review by Manuel [36] states that prophylactic antibiotic in hernia surgery can be given routinely and effectively reduces surgical site infections. However many of the trial included in the previous review by Manuel were published in the 1980s and 1990s.

Given this background, a literature review will be conducted to update the effectiveness of prophylactic antibiotics in preventing surgical site infections in hernia surgery patients based on current patient demographics.

## 2. METHODS

The research conducted is a systematic literature review and meta-analysis using articles with randomized controlled trial (RCT) designs in either Indonesian or English, published between the years 2010 and 2020. The search for articles was performed on databases such as PubMed and Google Scholar using the keywords "prophylactic antibiotic" AND "wound infection" AND "hernia repair" and "prophylactic antibiotic AND surgical site infection AND hernia surgery". The articles included in the study covered research topics on adult patients undergoing hernia surgery with prophylactic antibiotic intervention compared to placebo or no antibiotics, with the outcome being the occurrence of surgical site infections. Articles that were not accessible in full text were excluded from the research. The analysis of the articles was based on the relevance of the content to the research topic, completeness of the source's bibliographic information, source reputation, risk of bias, and article quality.

Two independent reviewers assessed the article using the inclusion and exclusion criteria as the basis for the studies selection and use the Critical Appraisal Skills Programme (CASP checklist) to assess the study

quality. The selected articles were then combined into a single unit and subjected to statistical analysis using Review Manager 5.4 software

## 3. RESULTS AND DISCUSSION

### 3.1. Article Selection

Based on the article search conducted, a total of 64 articles were found in the PubMed database, and 998 articles were found in the Google Scholar database. After removing duplicates, there were 1018 articles. These articles then underwent screening based on their titles, abstracts, and relevance to the inclusion and exclusion criteria. Out of the 1018 articles, 994 were excluded from the study, leaving 24 selected articles for further analysis that addressed the research topic.

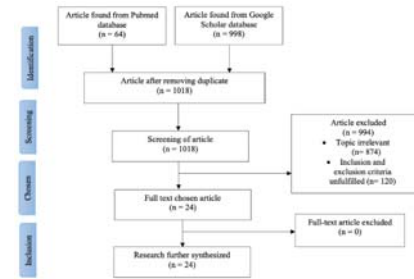


Figure 1 Article selection.

### 3.2. Chosen Article

The selected 24 articles involved research subjects who were hernia patients undergoing surgery. The majority of the subjects were adult male patients. Almost all subjects included in the studies had inguinal hernias, and the research was conducted in various locations across Asia. The characteristics of included articles are presented in Table 1.

Table 1. The occurrence of Surgical Site Infection Based on Studies

No	Author/year	Total Sample	Location of Research	Hernia Type	Result
1	Yadav, <i>et al</i> (2020)	200	India	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 6 out of 100 patients (6%) in the antibiotic group and 8 out of 100 patients (8%) in the control group.
2	Kahla, <i>et al</i> . (2019)	40	Mesir	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 1 out of 20 patients (2.5%) in the antibiotic group and 2 out of 20 patients (5%) in the control group.
3	Santhi, <i>et al</i> (2018)	60	India	Hernia inguinalis	The occurrence of Surgical Site

No	Author/year	Total Sample	Location of Research	Hernia Type	Result
					Infection (SSI) was observed in 0 out of 30 patients (0%) in the antibiotic group and 1 out of 30 patients (3%) in the control group.
4	Ray, <i>et al</i> (2018)	100	India	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 3 out of 50 patients (6%) in the antibiotic group and 4 patients out of 50 patients (8%) in the control group.
5	Sethi, <i>et al</i> (2017)	60	India	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 1 out of 30 patients (3%) in the antibiotic group and 1 out of 30 patients (3%) in the control group.
6	Siddiqui, <i>et al</i> (2017)	40	Bangladesh	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 2 out of 20 patients (10%) in the antibiotic group and 5 out of 20 patients (25%) in the control group.
7	Alagarsamy, <i>et al</i> (2017)	100	India	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 5 out of 50 patients (10%) in the antibiotic group and 7 out of 50 patients (14%) in the control group.
8	Bahar, <i>et al</i> (2015)	395	Iran	Hernia inguinalis, hernia epigastrik, hernia umbilikal, hernia insisional	The occurrence of Surgical Site Infection (SSI) was observed in 6 out of 237 patients (4.4%) in the antibiotic group and 2 out of 158 patients (1.3%) in the control group.
9	Vinoth, <i>et al</i> (2015)	60	India	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 2 out of 30 patients (6.7%) in the antibiotic group and 3 out of 30 patients (10%) in the control group.
10	Razack, <i>et al</i> (2015)	200	India	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 7 out of 94 patients (7.4%) in the antibiotic group and 8 out of 86 patients (9.5%) in the control group.
11	Akhtar, <i>et al</i> (2015)	150	Pakistan	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 2 out of 75 patients (2.7%) in the antibiotic group and 5 out of 75 patients (6.7%) in the control group.
12	Mazaki, <i>et al</i> (2014)	200	Jepang	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 2 out of 100 patients (2%) in the antibiotic group and 13 out of 100 patients (13%) in the control group.
13	Kochhar, <i>et al</i> (2014)	217	India	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 4 out of 106 patients (3.8%) in the antibiotic group and 5 out of 106 patients (4.7%) in the control group.
14	Ullah, <i>et al</i> (2013)	166	Pakistan	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 6 out of 83 patients (7.2%) in the antibiotic group and 15 out of 83 patients (18%) in the control group.
15	Javi, <i>et al</i> (2013)	54	Indonesia	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 1 out of 27 patient (3.7%) in the antibiotic group

No	Author/year	Total Sample	Location of Research	Hernia Type	Result
16	KC B, <i>et al</i> (2013)	60	Nepal	Hernia inguinalis	and 2 out of 27 patients (7.4%) in the control group. The occurrence of Surgical Site Infection (SSI) was observed in 0 out of 30 patients (0%) in the antibiotic group and 1 out of 30 patients (3.3%) in the control group.
17	Ergul, <i>et al</i> (2012)	200	Turki	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 5 out of 100 patients (5%) in the antibiotic group and 7 out of 100 patients (7%) in the control group.
18	Goyal, <i>et al</i> (2011)	200	India	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 1 out of 100 patients (1%) in the antibiotic group and 3 out of 100 patients (3%) in the control group.
19	Othman I. (2011)	98	Saudi Arabia	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 4 out of 50 patients (8%) in the antibiotic group and 6 out of 48 patients (12.5%) in the control group.
20	Phanthabordeekorn W (2011)	106	Thailand	Hernia inguinalis	No occurrence of Surgical Site Infection (SSI) observed in the antibiotic group and control group.
21	Al Fatah (2011)	200	Mesir	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 3 out of 100 patients (3%) in the antibiotic group and 5 out of 100 patients (5%) in the control group.
22	Shankar, <i>et al</i> (2010)	450	India	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 12 out of 172 patients (7%) in the antibiotic group and 17 out of 162 patients (10.4%) in the control group.
23	Ijaz, <i>et al.</i> (2010)	100	Pakistan	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 2 out of 50 patients (4%) in the antibiotic group and 5 out of 50 patients (10%) in the control group.
24	Thakur, <i>et al.</i> (2010)	55	India	Hernia inguinalis	The occurrence of Surgical Site Infection (SSI) was observed in 3 out of 29 patients (10.3%) in the antibiotic group and 4 out of 26 patients (15.3%) in the control group.

### 3.3. Article Quality and Reputation

The search for articles revealed 24 articles (Table 1) that will be analyzed for their quality. An article with a score of 9-11 on the checklist was classified as having a

good quality, 6-8 on the checklist rated as moderately good, and  $\leq 5$  on the checklist rated as poor quality. Article quality and reputation scoring can be seen in Table 2.

**Table 2.** Article quality and Reputation Scoring

No	Author	CASP Checklist	Article Quality
1	Goyal, <i>et al.</i>	7/11	Moderately good quality
2	Othman I.	8/11	Moderately good quality
3	Bahar, <i>et al.</i>	7/11	Moderately good quality
4	Shankar, <i>et al.</i>	7/11	Moderately good quality

No	Author	CASP Checklist	Article Quality
5	Vinoth, <i>et al.</i>	9/11	Good quality
6	Sethi, <i>et al.</i>	7/11	Moderately good quality
7	Razack, <i>et al.</i>	7/11	Moderately good quality
8	Ullah, <i>et al.</i>	8/11	Moderately good quality
9	Siddiqui, <i>et al.</i>	7/11	Moderately good quality
10	Ergul, <i>et al.</i>	8/11	Moderately good quality
11	Alagarsamy, <i>et al.</i>	8/11	Moderately good quality
12	Phanthabordeekorn W	9/11	Good quality
13	Yadav, <i>et al.</i>	7/11	Moderately good quality
14	Mazaki, <i>et al.</i>	9/11	Good quality
15	Kahla, <i>et al.</i>	7/11	Moderately good quality
16	Ijaz, <i>et al.</i>	7/11	Moderately good quality
17	Thakur, <i>et al.</i>	8/11	Moderately good quality
18	Kochhar, <i>et al.</i>	8/11	Moderately good quality
19	Al Fatah	8/11	Moderately good quality
20	Javi, <i>et al.</i>	7/11	Moderately good quality
21	Akhtar, <i>et al.</i>	7/11	Moderately good quality
22	KC B, <i>et al.</i>	7/11	Moderately good quality
23	Santhi, <i>et al.</i>	8/11	Moderately good quality
24	Ray, <i>et al.</i>	8/11	Moderately good quality

### 3.4. Bias Assessment

The assessment of bias is conducted based on selection bias (randomization and allocation bias), performance bias, detection bias, attrition bias, and reporting bias. The bias assessment for each article can be seen in Figure 2.

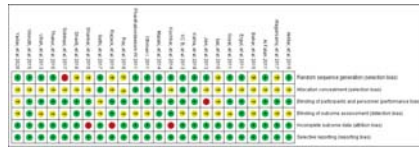


Figure 2. Bias Assessment.

### 3.5. Prophylactic Antibiotic

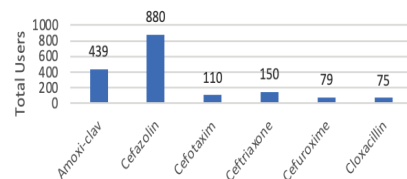


Figure 3. Total Use of Prophylactic Antibiotic.

Based on the research articles obtained, the prophylactic antibiotics used consist of six types: cefazolin [10, 11, 13, 14, 17, 19, 21-23, 27], Co-amoxiclav [8, 9, 15, 25, 26], Cefuroxime [16, 24, 29], Cefotaxime [12, 18, 30], Ceftriaxone [20, 31], and

Cloxacillin [28]. A placebo or no antibiotic was used as the comparative control. Among these antibiotics, Cefazolin was the most frequently used prophylactic antibiotic in the collected research results.

Based on the six types of prophylactic antibiotics (Figure 3), the antibiotic classes used consisted of Penicillin (Amoxiclav and Cloxacillin) and Cephalosporin (Cefazolin, Cefotaxime, Ceftriaxone, and Cefuroxime). These antibiotic classes are effective against a wide range of Gram-Positive and Gram-Negative microorganisms [32], particularly those commonly found as pathogens in surgical site infections, such as *S. aureus*. Aside from the efficacy of the antibiotics, the antibiotics chosen were based on their safety, pharmacokinetics, and reasonable cost per dose. Cephalosporin antibiotics, especially Cefazolin, are widely used and generally considered the first-choice prophylactic antibiotic for surgical procedures [34].

### 3.6. Surgical Site Infection Occurrence

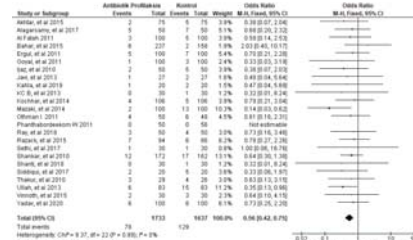


Figure 4. Forest plot on surgical site infection

occurrence on prophylactic antibiotics group and control group on hernia post- surgery patients

The occurrence of surgical site infections (SSI) was observed during the specified follow-up period in each study, usually for 1 month after the surgery. The follow-up results showed that some patients experienced surgical site infections in all studies (as seen in **Figure 4**), both in the antibiotic group and the control group, except for the study by Phanthabordeekorn W. (2011). Phanthabordeekorn reported that there were no patients who experienced surgical site infections in either the antibiotic group (0%) or the control group (0%). The total incidence of surgical site infections among all hernia surgery patients in this research was 78 patients (4.5%) in the antibiotic group and 129 patients (7.88%) in the control group. The incidence rate of surgical site infections was higher in the control group compared to the antibiotic group.

Based on the statistical analysis conducted on the 24 articles, a significant difference was found between the antibiotic group and the control group in preventing surgical site infections, with a P-value < 0.0001 (OR = 0.56; 95% CI = 0.42–0.75). The results between the studies appear to be homogeneous, indicating no heterogeneity (Chi2 P = 0.99 and I2 = 0%). The use of two types of antibiotic classes in this research, namely Penicillin and Cephalosporin, does not seem to demonstrate a significant difference in their effect on the occurrence of surgical site infections.

Based on the 24 articles, two of them showed significant differences in the incidence of surgical site infections. In the study conducted by Ullah [15], the patients who experience SSI reach a total of 21 cases out of 186 patients, with 6 cases out of 83 patients (7.23%) in the antibiotic group and 15 cases out of 83 patients (18.1%) in the control group. On the other hand, in the study by Mazaki [21], the patients who experienced SSI reached a total of 15 cases out of 200 patients, with 2 cases out of 100 patients (2%) in the antibiotic group and 13 cases out of 100 patients (13%) in the control group. The remaining 22 studies did not show significant differences in their results.

According to guidelines from EHS [6] and the International Guidelines for Groin Hernia Management [33], the use of prophylactic antibiotics is not recommended for hernia surgery because it is not significant in reducing the amount of SSI occurrence. Findings in this study and the recommended guidelines showed a significant difference in preventing or reducing SSI occurrence. Hernia surgery is categorized as a clean surgical procedure where the risk of surgical site infection is considered low, typically less than 5%. However, the findings from the collected articles indicate that the incidence of surgical site infections in hernia surgery appears to be higher than what was

originally estimated. Several factors may contribute to this discrepancy, including patient-related, procedural, and microbial factors. Patient-related factors, such as advanced age, poor nutritional status, and the presence of comorbidities like diabetes mellitus, can increase the risk of surgical site infections. Procedural factors such as surgical preparation, operative equipment, the operating room environment, operative duration, and surgical technique can significantly influence the risk of infection. Microbial factors, including the type and quantity of microorganisms present at the surgical site.

The reported bacterial cultures from several studies included in the analysis are *S. aureus* [9-11, 13, 14, 16, 17, 21, 23-26, 28, 30, 31], *Hemolytic streptococci* (*Streptococcus pyogenes*) [9, 26], *Pseudomonas aeruginosa* [9, 21], *S. epidermidis* [10, 23, 26], *Streptococci* [11, 14], *Klebsiella pneumoniae* [10, 13, 16], *E. coli* [11, 14, 16], *Enterobacteria* [11], *Enterococcus faecalis* [21], *Coagulase-negative Staphylococcus* [17], *Corynebacterium spp.*, and *Methicillin-resistant S aureus* [21]. The majority of the studies reported that the bacterium *S. aureus* was most commonly found in surgical site infections. *S. aureus* is often part of the normal endogenous flora present in patients [35].

The results of this study are consistent with previous meta-analyses conducted by Manuel [36], which also showed significant differences between the prophylactic antibiotic group and the control group in preventing surgical site infections in hernia surgery patients, with respective P-values of 0.004 and 0.003.

Based on the results of this study, prophylactic antibiotics can be given to hernia surgery patients. However, before administering prophylactic antibiotics, it is still necessary to pay attention to the patient's conditions and risk factors.

There are several limitations in this study. First, we included only those studies published between 2010 and 2020. The reviewer considered article that was published before 2010 to be outdated. Second, we only included articles that use Indonesian and English language. Other language is excluded because of the cost and time involved in translating. Another limitation is that there are several articles with unobtainable full-text. Some relevant articles may be missed due to these limitations

## CONCLUSION

The effectiveness of prophylactic antibiotic use shows a significant difference in preventing surgical site infections in hernia surgery patients compared to the placebo or without prophylactic antibiotic group; therefore, it can be given to patients who undergo hernia surgery, taking into account their risk factors.

## REFERENCES

- [1] Devi BM Pabitha, Saravanakumar. (2019). Surgical site infection in a tertiary care centre-an overview - A cross sectional study. *International Journal of Surgery*, *38*(3), pp. 139–144. doi: <https://doi.org/10.1016/j.ijso.2019.09.008>.
- [2] Singh, R., Singla, P. and Chaudhary, U. (2014) Surgical site infections: classification, risk factors, pathogenesis and preventive management. *International Journal of Pharma Research and Health Sciences*, *2*(3), pp. 203–214.
- [3] Dabbas, N., Adams, K., Pearson, K., & Royle, G. (2011). Frequency of abdominal wall hernias: is classical teaching out of date?. *JRSM short reports*, *2*(1), 5. <https://doi.org/10.1258/shorts.2010.010071>.
- [4] Cohdijayanty, A. (2006) Studi penggunaan antibiotik pada pasien bedah hernia inguinal (Penelitian pada Bagian Bedah RSU Dr.Soetomo Surabaya). Skripsi Fakultas Farmasi Universitas Airlangga.
- [5] Juvany, M., Hoyuela, C., Trias, M., Carvajal, F., Ardid, J., & Martrat, A. (2018). Impact of surgical site infections on elective incisional hernia surgery: A prospective study. *Surgical Infections*, *19*(3), 339–344. doi:10.1089/sur.2017.233.
- [6] Simons, M. P., Aufenacker, T., Bay-Nielsen, M., Bouillot, J. L., Campanelli, G., Conze, J., de Lange, D., Fortelny, R., Heikkinen, T., Kingsnorth, A., Kukleta, J., Morales-Conde, S., Nordin, P., Schumpelick, V., Smedberg, S., Smietanski, M., Weber, G., & Miserez, M. (2009). European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. *Hernia: the journal of hernias and abdominal wall surgery*, *13*(4), 343–403. <https://doi.org/10.1007/s10029-009-0529-7>.
- [7] Mazaki, T., Mado, K., Masuda, H., & Shiono, M. (2013). Prophylactic antibiotic for the prevention of surgical site infection after tensionfree hernia repair: A Bayesian and Frequentist Meta-Analysis. *Journal of the American College of Surgeons*, *217*(5), 788–801.e4. doi:10.1016/j.jamcollsurg.2013.07.386.
- [8] Goyal, A., Garg, R., Jenaw, R. K., & Jindal, D. K. (2011) Role of prophylaxis antibiotics in open inguinal hernia repair: A randomised study. *Indian Journal of Surgery*, *73*(3), pp. 190–193. doi: 10.1007/s12262-010-0193-2.
- [9] Othman, I. (2011) Prospective randomized evaluation of prophylactic antibiotic usage in patients undergoing tension free inguinal hernioplasty. *Hernia*, *15*(3), pp. 309–313. doi: 10.1007/s10029-011-0783-3.
- [10] Mehrabi Bahar, M. et al. (2015) The role of prophylactic cefazolin in the prevention of infection after various types of abdominal wall hernia repair with mesh. *Asian Journal of Surgery*, *38*(3), pp. 139–144. doi: 10.1016/j.asjsur.2015.01.006.
- [11] Shankar, V. G., Srinivasan, K., Sistla, S. C, & Jagdish, S. (2010) Prophylactic antibiotics in open mesh repair of inguinal hernia - A randomized controlled trial. *International Journal of Surgery*, *8*(6), pp. 444–447. doi: 10.1016/j.ijso.2010.05.011.
- [12] Vinoth, N., Karthikeyan, C. and Parmar, H. (2015) Role of prophylactic antibiotic in open inguinal hernioplasty – A prospective randomized clinical trial. *IAIM*, *2*(3), pp. 57–67.
- [13] Griwan, D. D. S. & D. M. S. (2017) The role of prophylactic antibiotic in prevention of wound infection after lichtenstein open mesh repair of primary inguinal hernia: A multicenter double-blind randomized controlled trial. *International J. of Healthcare and Biomedical Research*, *5*(3), pp. 24–35. doi: 10.1097/01.sla.0000145926.74300.42.
- [14] Razack, A., Kapoor, K. K. and Tambat, R. M. (2015) The role of single dose prophylactic antibiotic in open mesh repair of inguinal hernia: a prospective, double blind randomized trial. *Journal of Evolution of Medical and Dental Sciences*, *4*(35), pp. 6017–6026. doi: 10.14260/jemds/2015/877.
- [15] Ullah, B., Khan, S. A., Ahmed, S., & Pasha, T.. (2013) Efficacy of preoperative single dose antibiotic in patients undergoing mesh repair for inguinal hernia. *Journal of Ayub Medical College, Abbottabad: JAMC*, *25*(1–2), pp. 103–105.
- [16] MAR Siddiqui., Aleem MA, Rahman MS, Z. F. (2017) Role of prophylactic antibiotics in open mesh inguinal hernia repair. *Journal of Armed Forces Medical College (JAFMC) Bangladesh*, *13*(2), pp. 18–21.
- [17] Ergul, Z., Akinci, M., Ugurlu, C., Kulacoglu, H., & Yilmaz, K. B. (2012) Prophylactic antibiotic use in elective inguinal hernioplasty in a trauma center. *Hernia*, *16*(2), pp. 145–151. doi: 10.1007/s10029-011-0881-2.
- [18] Alagarsamy, G. S. and Ramasamy, R. (2017) The efficacy of prophylactic antibiotic in preventing SSI (surgical site infection) in patients undergoing Lichtenstein's hernioplasty at our tertiary care centre. *International Surgery Journal*, *4*(6), p. 1922. doi: 10.18203/2349-2902.isj20172054.
- [19] Phanthabordeekorn, W. (2011) Effectiveness of prophylaxis antibiotic used for blinded placebo-controlled Trial. *The Thai Journal of Surgery*, *32*, pp. 137–140.



- [20] Yadav, S., Kchhawa, D. S. and Meena, J. (2020) Effect of prophylactic antibiotic in open inguinal hernioplasty (Lichtenstein hernia repair): a study in tertiary care center. *International Surgery Journal*, 7(12), pp. 4034–4038. doi: 10.18203/2349-2902.isj20205353.
- [21] Mazaki, T., Mado, K., Masuda, H., Shiono, M., Tochikura, N., & Kaburagi, M. (2014) A randomized trial of prophylactic antibiotic for the prevention of surgical site infection after open mesh-plug hernia repair. *American Journal of Surgery*, 207(4), pp. 476–484. doi: 10.1016/j.amjsurg.2013.01.047.
- [22] Kahla, S. H., Gaber, A. and Al-Rahawy, M. A. (2019) The role of prophylactic antibiotic in the prevention of surgical-site infection after hernioplasty in Menoufia University Hospital. *Menoufia Medical Journal*, 32(3), pp. 1137–1141. doi:10.4103/mmj.mmj\_10\_16.
- [23] Ijaz A, A. S. (2010) Post operative wound infection: Prevention The role of prophylactic antibiotic in lichtenstein hernia repair. *Professional Medical Journal*, 17(6), pp. 174–179.
- [24] Thakur, L., Upadhyay, S., Peters, N. J., Saini, N., & Deodhar, M. (2010) Prophylactic antibiotic usage in patients undergoing inguinal mesh hernioplasty - A clinical study. *Indian Journal of Surgery*, 72(3), pp. 240–242. doi: 10.1007/s12262-010-0051-2.
- [25] Kochhar, G., Andley, M., Saha, S., Kumar, A., Pusuluri, R., Saurabh, G., Kumar A. (2014) Randomized controlled trial to evaluate the role of prophylactic antibiotic in Lichtenstein hernia repair. *Journal of Young Medical Researchers*, 1(331), pp. 1–8.
- [26] Al-Fatah, M. A. (2011) The role of prophylactic antibiotic in prevention of wound infection after Lichtenstein repair of primary inguinal hernia. *Al-Azhar Assiut Medical Journal*, 9(1), pp. 173–180.
- [27] Y Saskia Javi, Sudaratana, I.K., and Raka Widiana, I. (2013) Effect of prophylactic antibiotic on surgical site. *Bali Medical Journal*, 2(2), pp. 55–58.
- [28] Orelia, C. C., van Hessen, C., Sanchez-Manuel, F. J., Aufenacker, T. J., & Scholten, R. J. (2020). Antibiotic prophylaxis for prevention of postoperative wound infection in adults undergoing open elective inguinal or femoral hernia repair. The Cochrane database of systematic reviews, 4(4), CD003769. <https://doi.org/10.1002/14651858.CD003769.pub5>
- [29] Bidur, K. C., Regmi, R., Agrawal, C. S., Pathania, O. P. (2013) Role of single dose prophylactic antibiotic in prevention of wound infection following lichtenstein inguinal hernioplasty: a randomized clinical trial. *Nepal Journal of Medical Sciences*, 2(2), pp. 108–113. doi: 10.3126/njms.v2i2.8952.
- [30] B, S., Robert, K. and Rengasamy, S. (2018) Role of prophylactic antibiotic in elective mesh inguinal hernioplasty. *Journal of Evidence Based Medicine and Healthcare*, 5(17), pp. 1427–1430. doi: 10.18410/jebmh/2018/298.
- [31] Ray, D., Bhaumik, A. and Saha, S. (2018) Role of prophylactic antibiotics in open mesh inguinal hernioplasty: A prospective study. *International Journal of Scientific Study*, 6(9), pp. 51–57. doi: 10.17354/ijss/2018/335.
- [32] Vardanyan, R., & Hruby, V. (2016). Antibiotics. *Synthesis of Best-Seller Drugs*, 573–643. doi:10.1016/b978-0-12-411492-0.00030-4.
- [33] Hernia Surge Group (2018). International guidelines for groin hernia management. *Hernia: the journal of hernias and abdominal wall surgery*, 22(1), 1–165. <https://doi.org/10.1007/s10029-017-1668-x>.
- [34] Bratzler, D. W., Dellinger, E. P., Olsen, K. M., Perl, T. M., Auwaerter, P. G., Bolon, M. K., Fish, D. N., Napolitano, L. M., Sawyer, R. G., Slain, D., Steinberg, J. P., Weinstein, R. A., American Society of Health-System Pharmacists, Infectious Disease Society of America, Surgical Infection Society, & Society for Healthcare Epidemiology of America. (2013) Clinical practice guidelines for antimicrobial prophylaxis in surgery. *American Journal of Health-System Pharmacy*, 70(3), pp. 195–283. doi: 10.2146/ajhp120568.
- [35] Negi, V., Pal, S., Juyal, D., Sharma, M. K., & Sharma, N. (2015). Bacteriological profile of surgical site infections and their antibiogram: A study from resource constrained rural setting of Uttarakhand State, India. *Journal of clinical and diagnostic research: JCDR*, 9(10). <https://doi.org/10.7860/JCDR/2015/15342.6698>.
- [36] Sanchez-Manuel, F. J., Lozano-García, J., & Seco-Gil, J. L. (2012). Prophylactic antibiotic for hernia repair. *The Cochrane database of systematic reviews*. <https://doi.org/10.1002/14651858.CD003769.pub4>.
- [37] CASP. CASP randomised controlled trial standard checklist. [https://caspuk.net/wpcontent/uploads/2020/10/CASP\\_RCT\\_Checklist\\_PDF\\_Fillable\\_Form.pdf](https://caspuk.net/wpcontent/uploads/2020/10/CASP_RCT_Checklist_PDF_Fillable_Form.pdf)



**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.



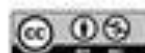
Johan Sukweenadhi  
Finna Setiawan *Editors*

Proceedings of the  
Conference on Natural  
Resources and Life  
Sciences 2022  
(NRLS-BIO 2022) • Volume 38

OPEN ACCESS

*Editors*  
Johan Sukweenadhi  
Faculty of Biotechnology  
University of Surabaya  
Surabaya, Indonesia

Finna Setiawan  
Faculty of Pharmacy  
University of Surabaya  
Surabaya, Indonesia



ISSN 2731-7846 ISSN 2468-5747 (electronic)  
Advances in Biological Sciences Research  
ISBN 978-94-6463-321-4 ISBN 978-94-6463-322-1 (eBook)  
<https://doi.org/10.2991/978-94-6463-322-1>

© The Editor(s) (if applicable) and The Author(s) 2023. This book is an open access publication.

**Open Access** This book is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this book are included in the book's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the book's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

This work is subject to copyright. All commercial rights are reserved by the author(s), whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilm or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Regarding these commercial rights a non-exclusive license has been granted to the publisher.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Atlantis Press imprint is published by the registered company Atlantis Press International B.V., part of Springer Nature.

The registered company address is: Van Godewijckstraat 30 3311 GX Dordrecht Netherlands

Paper in this product is recyclable.

## Contents

Peer-Review Statements .....	1
<i>Johan Sukweenadhi and Finna Setiawan</i>	
<b>Clinical and Community Pharmacy</b>	
Systematic Literature Review: Side Effect of <i>Moringa oleifera</i> Lam. ....	7
<i>Deborah Felinda Hari Wijaya, Alfian Hendra Krisnawan, Oeke Yunita, Krisyanti Budipramana, Karina Citra Rani, and Nikmatul Ikhlom Eka Jayani</i>	
Meta-Analysis on the effectiveness of the Use of Prophylactic Antibiotics in Preventing Surgical Site Infection in Patients with Hernia Surgery .....	18
<i>Heru Wijono, Febryza Kristin, Beryl Bayanaka Agustha Peerera, Fauna Herawati, and Rika Yulia</i>	
Analysis of Factors Affecting Adherence to Anti-Retroviral Treatment among HIV/AIDS Out-patients at the Dinoyo Public Health Centre .....	27
<i>Annisa Lazuardy, Yosi Irawati Wibowo, and Adji Prayitno Setiadi</i>	
<b>Food Biotechnology</b>	
<i>In Silico</i> Evaluation of Soybean Protein as Bioactive Peptide for Anti-Thrombotic Agent by Molecular Docking Study .....	39
<i>Fadilla Sherlyna, Muhammad Ilham Fahri, Arief Koesswanto, and Dandan Wang</i>	
Study of the Potential Use of Fermentation Methods to Increase Antioxidant and Antibacterial Activity of Fruit Peels: A Review .....	44
<i>Merry Meryam Martgrita, Nehemia Roito Hutajulu, Hanna Gretty Manik, and Adelina Manurung</i>	
Estimation of Shelf-life of Porang Glucomannan Analog Rice By Accelerated Shelf-life Testing (ASLT) Method .....	58
<i>Michael Surya Dharma, Yayon Pamula Mukti, Gisela Buschle-Diller, and Ardhia Deasy Rosita Dewi</i>	

Fortification of Dayak Onion Extract ( <i>Eleutherine palmifolia</i> (L.) Merr.) to Jelly Drink as a Functional Food .....	64
<i>Yayon Pamula Mukti, Berliana Yusup, Ardhia Deasy Rosita Dewi, and Se Chan Kang</i>	
<b>Healthcare Biotechnology</b>	
The Effect of <i>Bajakah Tampala</i> Stem ( <i>Spatholobus littoralis</i> Hassk) Extract on Clotting Time in Vitro .....	75
<i>Noza N. Moyananda, Rachmad P. Armanto, and Mariana Wahjudi</i>	
Analysis of Consumer Knowledge and Needs For Herbal Information .....	80
<i>Oeke Yunita and Erlin Theterissa</i>	
<i>Bst</i> polymerase enhancement a bioinformatics approach to improve <i>Bst</i> polymerase characteristics .....	86
<i>Jonathan, Ernest Suryadaja, and Sulistyo Emantoko D. Putra</i>	
Methylation Specific PCR (MSP): Nested PCR vs Unnested PCR .....	90
<i>Farizky Martriano Humardani, Lisa Thalia Mulyanata, Lady Theresa Adeodata Tanaya, Risma Ikawaty, Heru Wijono, Hikmawan Wahyu Sulistomo, Dini Kesuma, and Sulistyo Emantoko Dwi Putra</i>	
Natural Products Isolated from Various Parts of Mangosteen ( <i>Garcinia mangostana</i> L.) as Therapeutic Agent: A Review .....	96
<i>Arif Nur Muhammad Ansori, Yulanda Antonius, Ahmad Affan Ali Murtadlo, Viol Dhea Kharisma, Bayyinatul Muchtaromah, Muhammad Khaliim Jati Kusala, Dora Dayu Rahma Turista, Imam Rosadi, Vikash Jakhmola, Maksim Rebezov, Tarun Parashar, and Rahadian Zainul</i>	
Identification of ACEI Inhibitor Derived from <i>Ashitaba</i> 's Chalcones: An <i>in Silico</i> Approach .....	102
<i>Thomas Alessandro, Yulanda Antonius, Ardhia Deasy Rosita Dewi, Sin War Naw, Prita Ayu Kusumawardhany, Lanny Kusuma Widjaja, Hazrul Iswadi, and Mariana Wahjudi</i>	



**Plant Biotechnology**

Patchouli Alcohol Optimization from <i>Pogostemon cablin</i> Benth. cv. Sidikalang Leaves Using Response Surface Methodology .....	111
<i>Mochammad Firmansyah, Feri Irwansyah, Krisyanti Budipramana, Mochammad Arbi Hadiyat, Ida Bagus Made Artadana, and Popy Hartatie Hardjo</i>	
Explant surface sterilization protocol for micropropagation of <i>Amorphophallus muelleri</i> Blume .....	116
<i>Fenny Irawati, Agnes Natalia Wijaya, Anggi Manurung, Michael Anthony Thongiratama, Wina Dian Savitri, and Popy Hartatie Hardjo</i>	
Utilization of Tempeh Extract as an Organic Supplement Alternative for Banana Tissue Culture .....	122
<i>Alexander Willy Dimaswarabrata, Anastasia Tatik Hartanti, and Listya Utami Karmawan</i>	

**Pharmacology and Toxicology**

Anti-Inflammatory and Mucolytic Activity Test of Ethanol Extract Fennel Leaf ( <i>Foeniculum vulgare</i> Mill.) .....	133
<i>Syifatul Lutviani, Ita Nur Anisa, and Andreanus A. Soemardji</i>	
LFER and 3D-QSAR Analysis of Febrifugine Derivatives against <i>Plasmodium falciparum</i> FCR-3 Strain .....	138
<i>Nur Aina, Tegar Achsendo Yuniarta, and Dini Kesuma</i>	
Natural Dyes as Photosensitizers of <i>Propionibacterium acnes</i> .....	145
<i>Asmiyenti Djaliasrin Djalil, Aqshal Pramudya Susanto, Rizal Nandha Arisugita, Binar Asrining Dhiani, Muhammad Faris Maulidan, and Irfan Zamzani</i>	

**Pharmaceutical Technology**

Formulation of Chewable Gummy Tablet of <i>Moringa oleifera</i> L. Leaf Extract Using Combination Kappa Carrageenan and Iota Carrageenan .....	155
<i>Nabilaberty Prisma Gemilang, Nikmatul Ikhsan Eka Jayani, and Karina Citra Rani</i>	
Stability and antioxidant tests of ethanol extract liposome of moringa leaves ( <i>Moringa oleifera</i> ) .....	165
<i>Robert Tungadi, Teti Sutriyati Tuloli, and Sri Manovita Pateda</i>	