

Risk factor for inappropriate use of prophylactic antibiotics in inguinal hernia repair surgery

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ABSTRACT

Introduction: There are some complications that can arise after surgery, like surgical site infection (SSI). In hernia repair, SSI incidence is low. Hence, the clinical practice guideline (CPG) published by the HerniaSurge Group (THG) does not recommend prophylactic antibiotics for hernia repair. Despite the unnecessary use of prophylactic antibiotics, regarding patient safety, prophylactic antibiotics can be used. However, each hospital has its own CPG and recommended antimicrobials based on the infection cases in its site. Regarding antimicrobial resistances, evaluating prophylactic antibiotics is essential to prevent increasing incidence of antimicrobial resistance cases. The aim of this study is to evaluate the use of prophylactic antibiotics in hernia inguinal cases.

Materials and Methods: This cross-sectional analytic study used patients' medical records between 2015 to 2020. Demographic data, surgery data and the used antimicrobial data were extracted and written in case report form. Identification of risk factors for inappropriate use of prophylactic antibiotics was done using logistic regression. **Results:** We identified 55 inappropriate times of preoperative prophylactic antibiotic therapy cases out of 80 cases and 63 cases in post-operative antibiotics were different from the guideline. Statistical analysis did not find any factor related to inappropriate therapy time.

Conclusion: The misuse of prophylactic antibiotics was frequently found regarding the duration of prophylactic antibiotics in both pre- and post-surgery setting. Nonetheless, no risk factor was identified with the inappropriate use of prophylactic antibiotics.

KEYWORDS:

Prophylactic antibiotic, hernia inguinal, gyssens

INTRODUCTION

Some post-surgery complications such as surgical site infection (SSI) may happen in a surgical procedure. In hernia repair, SSI incidence is low.¹⁻⁵ Hence, the clinical practice guideline (CPG) published by The HerniaSurge Group (THG)¹ does not recommend prophylactic antibiotics for hernia repair. Moreover, the inappropriate use of antibiotics increases the risk of *Clostridium difficile* infection,

anaphylactic reaction and antimicrobial resistance (AMR).^{1,6-}

⁸ Regarding patient safety, however, a prophylactic antibiotic may be used for a patient at risk and high-risk environment.^{1,4}

To prevent antibiotic overuse and AMR, World Health Organisation in 2017 (WHO)⁹ classified antibiotics into assess, watch and reserve (AWaRe) based on probability of antibiotic getting resistance.¹⁰ In 2019, WHO recommended that only antibiotics in assess class be used as prophylactic antibiotics.¹⁰ Nevertheless, since every hospital's infection pattern and AMR cases are different, each hospital has its own CPG and recommended antimicrobials. Moreover, healthcare providers' knowledge about antimicrobials, especially a doctor, also influences the choice of antimicrobial drugs.¹¹ Hence, evaluation of antimicrobials prescription must be done. According to the Health Ministry of Republic Indonesia, Gyssen's flowchart can be used as a tool to evaluate antimicrobial prescriptions.¹²

Evaluating prophylactic antibiotics is essential to prevent the increasing incidence of antimicrobial resistance cases regarding AMR. This study aims to evaluate prophylactic antibiotics use in hernia repair surgery in our institute hospital based on its own CPG and identify risk factors for inappropriate use of prophylactic antibiotics.

MATERIALS AND METHODS

Study Design

This cross-sectional study used the medical record of inguinal hernia patients who underwent surgery between January 2015 and December 2020 with 18 years old as the minimum age. This study was approved by the Ethics Commission.

Immunosuppressed patients or patients in steroid therapy, pregnant or breastfeeding or at least have diabetes mellitus, heart diseases or chronic kidney diseases were excluded. A patient with positive bacterial culture 48 hours before surgery was also excluded. To minimise the bias during participant selection, any incomplete data was discussed further between authors.

Data Collection

Demography data such as age, sex, weight, height, comorbidities and length of stay were collected from patients'

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Table I: Modified Gyssens' Flowchart.¹³

A.	Appropriate decisions; all criteria of correct antimicrobial use are fulfilled
B.	Inappropriate indication; prescription of antimicrobials without the presence of infectious disease, or prescription of antimicrobials for an infection that does not need antimicrobial treatment.
C.	Inappropriate choice, including the inappropriate spectrum of the antimicrobial agent (too broad, too narrow, not effective), or inappropriate toxicity profile.
D.	Inappropriate application: inappropriate dosage, route of administration, administration time, and duration of therapy.
E.	Divergence from guidelines
F.	Insufficient data to judge the appropriateness of antimicrobial use.

Table II: Patients Characteristics.

Patients Characteristics	n
Total	80
Sex	
Male	79
Female	1
Age (years), Median (IQR)	62 (43 – 70)
18-29 years (%)	12 (15.00%)
30-39 years (%)	7 (8.75%)
40-49 years (%)	5 (6.25%)
50-59 years (%)	9 (11.25%)
60 years or more (%)	47 (58.75%)
Body Weight (kg), Median (IQR)	60.00 (54.5 – 68.5)
Body Height (cm), Mean (SD)	163.86 (±5.84)
Length of stay (day), Median (IQR)	2.45 (2.25 – 3.18)
Smoking Status	7 (8.75%)
ASA Status (%)	
1	17 (21.25%)
2	46 (57.5%)
3	17 (21.25%)
Wound Class (%)	
Clean	46 (57.5%)
Clean-contaminated	20 (25.00%)
Contaminated	0 (0.00%)
Dirty-infected	1 (1.25%)
N/D*	13 (16.25%)
Comorbidities	
Hypertension	30
Recurrent Inguinal Hernia	8

*N/D = No Data

Tabel III: Surgery profile.

Surgery Profile	n
Hernia Types (%)	
Reponibel	16 (20.00%)
Ireponibel/Incarcerated	13 (15.00%)
Strangulated	4 (5.00%)
N/D	48 (60.00%)
Surgery Cases (%)	
Elective	78 (97.50%)
Emergency	2 (2.50%)
Surgical Technique (%)	
Herniorrhaphy	72 (90.00%)
Hernioplasty	8 (10.00%)
Duration of surgery (Minutes), Mean (±SD)	51.52 (±16.01)

Table IV: The evaluation of the appropriateness of pre-surgery prophylactic antibiotics use.

Gyssens Criteria	n
Appropriate Use (%)	21 (26.25%)
Inappropriate Application (%)	
Wrong Doses	0 (0%)
Wrong Route of Administration	0 (0%)
Wrong Duration	0 (0%)
Wrong Timing	
Too Short	51 (63.75%)
Too Long	4 (5%)
*N/D	6 (7.5%)
Administration time before an incision (minute), Mean (SD)	121.18 (\pm 74.87)
Divergence from Guideline (%)	0 (0%)
Insufficient Data (%)	13 (16.25%)

*N/D = No Data

Table V: Evaluation of the appropriateness of post-surgery prophylactic antibiotic use.

Gyssens Criteria	n
Appropriate Use (%)	0 (0.00%)
Inappropriate Application (%)	
Wrong Doses	0 (0.00%)
Wrong Route of Administration	0 (0.00%)
Wrong Duration	0 (0.00%)
Too Short	2 (2.50%)
Too Long	15 (18.75%)
Duration of antibiotic use after surgery (day), Median (IQR)	1.71 (1.57 – 2.49)
Wrong Timing	0 (0.00%)
Divergence from Guideline (%)	63 (78.75%)
Insufficient Data (%)	0 (0.00%)

Table VI: Univariate logistic regression for independent association with inappropriateness use of pre-surgery prophylactic antibiotics.

Variable	p value	OR (95% CI)
Age		
18-29 years	0.884	1.066 (0.455 – 2.497)
30-39 years	0.998	-
40-49 years	0.677	1.228 (0.467 – 3.229)
50-59 years	0.539	1.156 (0.728 – 1.836)
60 years or more	0.292	1.058 (0.953 – 1.174)
Length of Stay	0.920	1.041 (0.474 – 2.286)
Smoking Status	0.999	-

medical records. Types of hernia, hernia cases, surgical technique and duration of surgery were collected as surgery profiles. For prophylactic antibiotics evaluation, antibiotic drugs, dose, timing and route of administration were used based on the modified Gyssens' flowchart.

Statistical Analysis

Demography data was collected, analysed and reported as a percentage for all nominal data. Numerical data were reported in mean with standard deviation (SD) or median with interquartile range (IQR).

Appropriateness of prophylactic antibiotics prescription was analysed using modified Gyssens' flowchart¹³ and reported in percentage. The modified Gyssens flowchart is shown in Table I.

To study the influence of demography data with appropriate prescribing, binary logistic regression was used while odds ratio (OR) and 95% confidence interval (95% CI) were given. Statistical significance was assigned at $p < 0.05$. All analyses were performed with IBM SPSS ver. 26.

RESULTS

Characteristics of Patients

A total of 84 patients were diagnosed with inguinal hernia and undergone hernia repair between 2015 and 2020. Four out of them were excluded because three were in steroid therapy and the one had an allergy to ketorolac and mefenamic acid. So, a total of 80 patients were included in this study. Table II shows the characteristics of the patients.

Surgery Profile

Reducible inguinal hernia dominated the cases with 16 out of 80 included data, followed by irreducible/incarcerated (13 cases) and strangulated (4 cases). The rest was missing. Table III shows the summary of the surgery profile.

Evaluation of Antibiotics Use

Ceftriaxone was used as a pre-surgery prophylactic antibiotic in all hernia repair patients with 2 g/day and can be divided into two doses. It was given intravenously.

Some errors were discovered during administration while using a modified version of Gyssens' flowchart with the hospital's CPG as a reference. Also, 13 data points were not included in the medical record. Table IV shows an overview of the evaluation of the appropriateness of pre-surgery prophylactic antibiotics use.

In post-surgery, same as pre-surgery, ceftriaxone was used, including doses and route of administration. Due to incomplete instruction in the hospital's CPG, CPG-THG was used as the reference for the post-surgery prophylactic antibiotic analysis. In CPG-THG, the duration of prophylactic antibiotics is limited to 5 days and only in incarcerated or strangulated cases. Table V summarises the evaluation of the appropriateness of post-surgery prophylactic antibiotics use. After the patient was sent home, antibiotics were given. Cefixime with doses 2×100 mg doses is the most prescribed prolonged antibiotic (88.75%) followed by cefadroxil with doses 2×500 mg (11.25%).

Risk Factor of Inappropriateness Use of Prophylactic Antibiotic

Binary logistic regression did not show any significance between inappropriateness use of prophylactic antibiotics with demography data. The result is given in Table VI.

DISCUSSION

Inguinal hernia surgery at our institute hospital was performed using prophylactic antibiotics as recommended by the hospital's CPG. Despite the availability of CPG, inappropriate use of antibiotics was identified mostly in the pre-surgical medication. There is no information about antibiotics being used for post-surgical medication. Hence, the evaluation was based on CPG THG.¹ Unfortunately, the analysis did not find an appropriate use of post-surgery prophylactic antibiotics. Moreover, some cases used a prolonged antibiotics which is not recommended by CPG THG.

Risk factor analysis did not find any significance with inappropriateness use of prophylactic antibiotics. Nonetheless, Servesky et al.¹⁴ reported that patients over 60 years were protective against SSI. Despite that, Servesky failed to track down the use of the prophylactic antibiotic. Hypothetically, there is any possibility that prophylactic antibiotics were used in these patients due to the immune system condition in geriatric can be considered, physiologically suppressed.¹⁵

Due to the inappropriateness in time of administration of pre-surgery prophylactic antibiotics, the hospital's CPG was

reviewed. It was found that the time of antibiotic administration is not written well in the CPG either in pre-surgery or post-surgery setting. This may confuse healthcare workers about when to start and stop the antibiotics. In this study, all patients were given antibiotics from the first day since the patient was administered until discharge even at home. Meanwhile, prolonged antibiotics use does not give any benefit in any surgical cases (RR = 0.89; 95% CI = 0.79 – 1.00), except cardiac and maxillofacial surgery.¹⁶ Hence, prophylactic antibiotics in hernia repair may be excessive. This misfortune should be noted as the excessive use of antibiotics increases AMR cases.^{6,8}

Despite the inappropriate timing of pre-surgery prophylactic antibiotics, especially 51 cases of too long, this may happen perhaps because the antibiotics had already been given since the first day of patient stay in the hospital. Therefore, the antibiotic had been administered long before the incision. The 30 to 60 minutes of administration before an incision is referred by the American Society of Health-System Pharmacist (ASHP)¹⁷ However, a systematic review by de Jonge et al.¹⁸ showed 120 minutes was the least tolerated time of prophylactic antibiotics administration. Otherwise, prophylactic antibiotics was not effective (OR = 5.26; 95% CI = 3.29 – 8.39). On the other side, the administration < 30 minutes also lost its protective property (OR = 1.07; 95% CI = 0.63 – 2.17).

In 2019, WHO recommends that only antibiotics in the assess group be used as prophylactic antibiotics while the rest must not be given unless multiple AMR is proven.¹⁰ In our institute hospital, the recommended prophylactic antibiotic for hernia repair is ceftriaxone, while ceftriaxone itself has been listed in the watch group since 2017.⁹ Regarding hernia repair, WHO suggests ceftazidime, an assess antibiotic, as the prophylactic.¹⁰

While our institute hospital's CPG recommends using prophylactic antibiotics in hernia repair, CPG THG1 and the Ministry of Health of Republic Indonesia¹⁹ are against it. For elective hernia repair, both guidelines do not support any use of prophylactic antibiotics due to a low incidence of SSI in hernia repair. Nevertheless, regarding patient safety, CPG THG recommends using prophylactic antibiotics limited to high-risk patients and high-risk environments.^{1,20} A high-risk environment is defined as SSI incidences is higher than 5% in the control group in an observational study.¹⁴ Serevesky et al.¹⁴ reported that inguinal hernia patients with diabetes mellitus, body mass index >35 kg/m², and smoking behaviour were at risk for developing SSI. Published by Cochrane library, a systematic review⁴ revealed no beneficence of prophylactic antibiotics use for hemiorrhaphy as it did not decrease SSI incidence (RR = 0.86; 95% CI = 0.56 – 1.33).⁴ Meanwhile, prophylactic antibiotics could be considered in hernioplasty regardless the statistical analysis was not significant enough to show any benefit (RR = 0.78; 95%CI = 0.44 – 1.37).⁴ The fact that there is a difference between our institute hospital's recommendation and up-to-date research article raises speculation that the inappropriate use of prophylactic antibiotics – either in pre-surgery or post-surgery – may often occur. Therefore, an update for hospital CPG is needed in order to reduce the inappropriate use of prophylactic antibiotics.

Despite the low incidence of SSI in hernia repair, the study highlights a significant misuse of prophylactic antibiotics both pre- and post-surgery. Therefore, clinicians should reconsider the routine use of prophylactic antibiotics in hernia inguinal cases and adhere more closely to evidence-based clinical practice guidelines. Meanwhile, the hospitals should regularly review and update their CPGs to reflect current antimicrobial resistance patterns and optimise patient outcomes.

The limitation of this study is that we only analysed the inappropriate use of antibiotics with demographic data of the patient and surgery profile at the time. The influence of physician's knowledge, attitude, and practice to choose either to use prophylactic antibiotic or not would give more comprehensive data, however, was not done yet in this study. Incompleteness of medical record was a challenged in this study. And the last, but not the least, because prophylactic antibiotic was used in all inguinal hernia patient since they had been admitted, no SSI were observed. Hence, the association between the use of prophylactic antibiotic and SSI could not be done.

CONCLUSION

The use of prophylactic antibiotics is debatable for preventing SSI. Hence, the evaluation regarding its use in clinical settings is important. In this study, the appropriate use of prophylactic antibiotics, both in pre-surgery and post-surgery settings, was evaluated. The misuse of prophylactic antibiotics was frequently found regarding the duration of prophylactic antibiotics in both pre- and post-surgery setting. Nonetheless, no risk factor was identified with the inappropriate use of prophylactic antibiotics.

CONFLICT OF INTEREST

The authors have declared there is no conflict of interest.

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