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Factors associated with the length of hospital stay post an open appendectomy

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ABSTRACT

Introduction: An appendectomy is the surgical removal of the inflamed vermiform appendix organ system. Patients who have had an appendectomy will be treated in hospital inpatient rooms for varying lengths of time, which is affected by several factors. This study aims to analyze the factors associated with the length of hospital stay post an appendectomy in Arun Lhokseumawe hospital, Aceh between 2019 and 2020. The factors analyzed are age, gender, type of appendicitis, duration of surgery, and comorbidity.

Method: A retrospective study with an analytical descriptive cross-sectional study design. The sampling technique used was purposive sampling with a total of 251 samples. All data analysis used SPSS 26.

Results: The characteristics of patients were as follow: age 17 – 25 years old (25.15), female (58.2%), acute appendicitis (57.8%), and no comorbidity (66.1%). The statistical analysis by Chi-square $\alpha = 0.05$ provides the factors associated with the length of hospital stay after an appendectomy, such as gender ($p = 0.000$), type of appendicitis ($p = 0.000$), and comorbidity ($p = 0.000$). Whereas age ($p = 0.059$) and the duration of surgery ($p = 0.052$) were not related to the length of hospital stay after an appendectomy.

Conclusion: There were significant relationships between the following factors, such as age, type of appendicitis, comorbidity, and the length of hospital stay after an appendectomy procedure in Arun Lhokseumawe hospital, Aceh.

Keywords: Appendicitis, characteristic, length of hospital stays, post appendectomy.
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INTRODUCTION

The most common cause of acute abdominal pain is appendicitis, which is an inflammation of the appendix vermiformis. Acute abdominal pain occurs in 7 – 10% of medical emergencies. Appendicitis can affect people of all ages, although it is most common in people between the ages of 10 and 30 years old.[1] According to the data from the Ministry of Health of the Republic of Indonesia (Depkes RI) in 2012, appendicitis is the fourth most prevalent disease after dyspepsia, gastritis, duodenitis, and other digestive system diseases, with a total of 28,040 inpatient cases.[1]

Appendicitis is quite common in Indonesia, as evidenced by the growing number of patients each year. According to the Ministry of Health, there were 65,755 appendicitis cases in 2016 and 75,601 cases in 2017, indicating an increase in the number of appendicitis patients from year to year.[2]

The most serious complication of appendicitis is the perforation of the appendix that occur due to an abscess and may progress to peritonitis and shock and endangering the patients.[3] Perforation occurs in 16% to 40% of patients, with the highest occurrence in the younger age group (40 – 57%) and those over 50 years old (55 – 70%). Acute appendicitis without gangrene has a below 0.1% risk of mortality, but it rises to 0.6% in acute appendicitis with gangrene. Whereas perforated appendicitis has a mortality rate of up to 5%.[1]

Appendectomy is a surgery to remove the inflamed appendix vermiformis. Annually, there were more than 300,000 appendectomy procedures conducted in the United States.[1] The procedure has a 4 – 15% postoperative complication risk. Surgical complications are responsible for 0.2% - 0.8% of death caused by appendicitis. The mortality rate in pediatric patients ranges from 0.1% to 1%, but in the elderly over 70 years old, the rate increases to over 20%, owing to diagnostic and therapeutic delays.[4] The incision made in appendectomy leaves deep wounds that may cause various postoperative complication issues and require time to completely heal with constant or continuous care. Moreover, a hospital stays may become prolonged and may not be up to the standard. Furthermore, a prolonged hospital stay increases doctor visits which subsequently increases the expense of hospital treatment.[5]

Length of stay (LOS) is one of the indicators used in managing the utility of a hospital's facility, as well as to assess the quality and efficiency of provided hospital service. Some studies reveal that LOS for patients who undergo laparoscopic appendectomy was 1-8 days. Should there be a prolonged hospital stay, then the service could be concluded as less effective and efficient.[6] LOS is associated with several predictor factors, such as patients' characteristics, clinical condition, medical actions, patients' management, or other

problems related to the administration process of the hospital.[7] Acknowledging those factors may allow the hospital to improve its provided service and reduce unnecessary costs by providing suitable service. Therefore, the researchers of this paper would like to assess the characteristics (age and gender), clinical condition (the type of appendicitis and underlying diseases), and medical action (the duration of surgery) of patients after an appendectomy that is associated with the length of hospital stay.

METHOD

This research was a retrospective study with an analytical description cross-sectional research design to analyze the factors associated with the length of hospital stay after an open appendectomy procedure in Arun Lhokseumawe hospital, Aceh 2019 to 2020. This research was carried out in the medical record department in the related hospital from December 2021 to January 2022. The research population was all medical records for inpatients receiving appendectomy surgery in the hospital between January 2019 and December 2020. There was a total of 267 inpatients. Sampling was not random (non-probability sampling) with a purposive sampling technique. The samples were selected from the research population following the inclusion and exclusion criteria. Inclusion criteria were an inpatient whose medical record was complete, diagnosed with acute appendicitis, perforated appendicitis, or chronic appendicitis, and discharged after an appendectomy procedure. Exclusion criteria were patients with indicated sepsis or declared death after appendectomy. The research sample size that met the criteria was 251 samples.

The dependent variables in this research were the length of hospital stay after an open appendectomy. While the independent variables were age, gender, type of appendicitis, duration of surgery, and presence of comorbidity. The data was collected using a case report form or patient medical records from Arun Lhokseumawe hospital between 2019 and 2020. In this study, univariate and bivariate analyses were employed with the Chi-square test and a 5% ($\alpha = 0.05$) significant difference by using SPSS 25.0.

RESULT

The distribution of the sample was quite similar compared between 2019 and 2020 with 128 and 123 respondents, respectively. This result shows that the number of appendicitis cases slightly decreased within the period of study. Table 1 showed the distribution of 251 research subjects who met the research criteria.

The results of the univariate analysis in Table 2 show the distribution of the frequency of hospital stay duration post an appendectomy in the related hospital, where 204 (81.3%) patients were hospitalized for 4 days or less than that and 47 (18.7%) patients were hospitalized for more than 4 days.

The frequency distribution of age of the research subjects showed that the highest number of respondents were teenagers (17–25 years old), with a total of 63 (25.1%) patients. Whereas the least frequent patients were neonates and infants (0 – 5 years old) and elderly above 65 years old, where there were only 3 (1.2%) patients and 4 (1.6%) patients recorded, respectively.

Based on gender, over half, such as 146 (58.2%) of the respondents were female and 105 (41.8%) respondents were male (Table 2). As for the type of appendicitis, over half of the patients, such as 145 (57.8%) patients, were suffering from acute appendicitis, 75 (29.9%) patients had perforated appendicitis, and 31 (12.4%) had chronic appendicitis. For the duration

Table 1. Research sample distribution.

Year	Frequency (n)	Percentage (%)
2019	128	51,0
2020	123	49,0
Total	251	100,0

Table 2. Research sample characteristic distribution.

Respondent characteristic	Frequency(n)	Percentage (%)
Length of hospital stay post appendectomy		
≤ 4 days	204	81.3
> 4 days	47	18.7
Age		
0-5 years old	3	1.2
6-10 years old	25	10.0
12-16 years old	51	20.3
17-25 years old	63	25.1
26-35 years old	37	14.7
36- 45 years old	32	12.7
46-55 years old	22	8.8
56-65 years old	14	5.6
> 65 years old	4	1.6
Gender		
Male	105	41.8
Female	146	58.2
Type of appendicitis		
Acute appendicitis	145	57.8
Perforated appendicitis	75	29.8
Chronic appendicitis	31	12.4
Duration of surgery		
Short (< 1 hour)	98	39.0
Medium (1-2 hours)	153	61.0
Long (> 2 hours)	0	0.0
Comorbidity		
Present	85	33.9
Not present	166	66.1

of surgery, the appendectomy procedure in the related hospital from 2019 to 2020 was dominated by surgeries that lasted for 1 to 2 hours (medium), recorded at 153 (61%) procedures. No record of long-hour surgeries (above 2 hours). Finally, for the presence of comorbid, over one-third, such as 85 (33.9%) patients had comorbidity, while 166 (66.1%) patients were not presented with any comorbidity.

The results of the statistical analysis by using Chi-square in Table 3 shows no significant relationship between age and the length of hospital stay post an appendectomy (p>0.05). But there was a significant relationship between gender and the length of hospital stay post an appendectomy (p<0.05). Moreover, there was a significant relationship between the type of appendicitis and the length of hospital stay post appendectomy (p<0.05). There was, however, no significant relationship either between the duration of surgery or comorbidity and the length of hospital stay post an appendectomy (p<0.05).

Table 3. Factors associated with the length of hospital stay post open appendectomy.

Variable	Length of hospital stay				P *value*
	≤4 days		>4 days		
	n	%	n	%	
Age					
0-5 years old	1	33.3	2	66.7	
6-10 years old	21	84	4	16.0	
12-15 years old	46	90.2	5	9.8	
17-25 years old	56	88.9	7	11.1	
26-35 years old	28	75.7	9	24.3	
36- 45 years old	22	68.8	10	31.2	0.059
46-55 years old	16	72.7	6	27.3	
56-66 years old	11	78.6	3	21.4	
> 65 years old	3	75	1	25	
Gender					
Male	74	70.5	31	29.5	0.000
Female	130	89.0	16	11.0	
Type of appendicitis					
Acute appendicitis	135	93.1	10	6.9	0.000
Perforated appendicitis	39	52.0	36	48.0	
Chronic appendicitis	30	96.8	1	3.2	
Duration of surgery					
Short (< 1 hour)	86	87.8	12	12.2	0.052
Medium (1-2 hours)	118	77.1	35	22.9	
Long (> 2 hours)	0	0	0	0	
Comorbidity					
Present	41	48.2	44	51.8	0.000
Not present	163	98.2	3	1.8	

DISCUSSION

The characteristics of inpatients post an appendectomy in Arun Lhokseumawe hospital were dominated by teenagers aged 17 – 25 years old (25.1%), female (58.2%), and diagnosed with acute appendicitis (57.8%) without any comorbidity (66.1%). This research also showed that the average hospital stay for an appendectomy procedure was 4 days. These results were in line with the study done by Guanche Garcell (2019) who reported that the average length of stay of patients after an appendectomy was 3.94 days.[8]

The length of hospital stay is one way of measuring the effectiveness and efficiency of a hospital to provide quality care and services. This research showed that the average hospital stay was 4 days, which was still within the minimal hospital service criteria. The ideal length of hospital stay for an appendectomy was 3 – 5 days.[9] Acute appendicitis involves a minimum care after an appendectomy. Therefore, most patients recover quickly and can be discharged on the third or fourth-day post-surgery.[10]

For the inpatient age group, the highest number of patients recorded were teenagers, between 17 and 25 years old. The lowest number of patients recorded were in the neonates and infants (0 – 5 years old) and elderly above 65 years old age groups. Acute appendicitis is most common in late teens and early 20s, and the prevalence gradually decreases after the age of 30 years old.[11] Nonetheless, the condition can be found in all ages. Children under the age of 1 year old have a conical vermiform appendix, which narrows at the tip and widens at the base, resulting in low appendicitis incidence at that age.[12] Meanwhile, the maximal development of lymphoid tissue during adolescence becomes the factor that increases the frequency of appendix obstruction and causes intraluminal pressure.[13,14] Besides that, a poor diet during adolescence involving fast food and a low-fiber diet may lead to constipation, increase the intercaecal pressure, trigger the obstruction of vermiformis appendix, and increase the growth of intestinal flora that facilitate appendicitis.[15] Low appendicitis incidence in the elderly is due to the decrease in lymphoid tissue and alterations in the submucosal layer of the vermiformis appendix that decreases the ability to stretch the appendix.[15]

Over half of the respondents in this research were female. The risk of acute appendicitis is higher in males than females (8.6% vs. 6.7%). However, female is at higher risk to require appendectomy than male (23.1% vs. 12%).[12,16] This simply explained the finding in this study where there were more female respondents than male respondents. The research done by Zhang (2020) reported a similar result to this study, in which there were more appendectomy interventions in

women than in me.[16] However, the research conducted in Sanglah Central General Hospital, Denpasar, Bali in 2018 reported more male patients underwent appendectomy (58.2%) than female patients. Women may have a lesser number of lymphoid tissues than men. Therefore, in men, lymphoid hyperplasia can occur, making infections more likely.[14]

The most common diagnosis for appendicitis in this study was acute appendicitis, compared to perforated and chronic appendicitis. The clinical manifestation of acute appendicitis is specific, allowing doctors to early diagnose acute appendicitis. On the contrary, the diagnosis of perforated appendicitis is guided by prior acute appendicitis diagnosis. Perforated appendicitis is a complication form of acute appendicitis that occurs due to complications or inadequate treatment.[14,15]

This research shows no significant relationship between a patient's age and the length of hospital stay after an appendectomy. This result is not in accordance with the result by Zhang (2020) who reported a significant difference between age and ≤3 days and >3 days of hospital stay (37.10 ± 13.52 years old vs 42.94 ± 15.57 years old, respectively, P<0.01). Zhang (2020) showed that the length of hospital stay is proportional to the increase in age. Older patients may require prolonged hospital stays. The Elderly is at risk of malnutrition which may increase the risk of post-operative infections. Therefore, elderly patients need a longer time to recover after the surgery.[16] Besides that, age also affects the ability to heal wounds. A young female heals faster than an older woman experiencing menopause as a natural occurrence due to the decrease in hormone that may also affect wound healing ability.[17,18] The rate of cell repair is proportional to a person's age of growth or maturity. However, the aging process might slow down the cell repair mechanism, resulting in delayed wound healing.[17]

Physiologically, younger patients may recover faster than older patients because the body's immune system to phagocytes decreases with age. The dysfunction in the immune system can play a role in the progression of a disease. But, not only age, but lifestyle patterns can also influence the length of hospital treatment to ensure complete wound healing.[7] In this study, there was no significant relationship between age and the length of hospital stay after an appendectomy. Age is not the only factor that prolonged the requirement of treatment.

There are other internal factors that affect the rate of wound healing and subsequently impact the length of hospital stay. Those factors are nutritional intake, BMI and mobilization may affect the speed of post-operative wound healing. Obesity is one of the factors that hinder wound healing. The fat tissues in obese individuals are susceptible to infections. Those tissues lack adequate blood supply to send cellular elements and nutrition required for recovery and resist bacterial infections. The process of wound healing is hindered when the damaged tissues do not immediately receive the required nutrition for recovery. Consequently, the hospital stay will be prolonged. Mobilization also plays an important role, where early mobilization can accelerate post-operative wound healing and the recovery of intestinal peristalsis in post-surgery patients.[17]

This research showed a significant relationship between gender and the length of hospital stay after an appendectomy. Maharani (2020) also reported a significant relationship between gender and the length of hospital stay in the study involving post appendectomy patients in Dr. H. Abdul Moeloek's regional general hospital Lampung.[19] Our study found that female patients had shorter hospital stays than males, which can be explained by the hormonal influence in females, allowing them to heal faster than males. Estrogen is the main sexual hormone in women. During childhood, estrogen is secreted only in a small amount, but at puberty, the amount secreted in teenage girls under the influence of gonadotropin hypophysis may increase 20-fold or more.[20]

Estrogen plays an important role in the wound healing phase by modifying inflammation reaction, accelerating re-epithelialization, stimulating the formation of granulation, regulating proteolysis, and balancing the synthesis and degradation of collagen. These are parts of the physiological process of wound healing, such as the hemostasis/inflammation phase, proliferation phase, and remodeling phase to hold the integrity of the skin after trauma, either due to accidents or medical procedures.[21]

There is immediate hemostasis and the onset of inflammation in the first wound healing phase, which is mediated by the local activation of the coagulation system, hematopoietic system, inflammatory cells, and immune system. The estrogen signal transduction played a major role in the coagulation system. Estrogen can raise fibronectin levels in wounds while lowering the elastase activity and slowing fibronectin breakdown. The hormone influence wound healing by suppressing the local inflammatory responses through the macrophage inhibitor factor (MIF). MIF reduces the ability of macrophages to phagocyte foreign particles and germs in the area of the wound, causing the inflammatory process to last longer. Therefore, the presence of estrogen can reduce MIF expression and aid the wound healing process. Moreover, estrogen helps wound closure and collagen deposition by suppressing purulent inflammation, reducing the expression of pro-inflammatory cytokines, such as tissue necrotic factor (TNF-α), and decreasing the synthesis of elastase.[21]

Estrogen is also involved in the proliferative phase of wound healing, specifically the proliferation, migration, and differentiation of fibroblasts. Fibroblasts are a type of mesenchymal cell connective tissue that stores the collagen and extracellular matrix (ECM) elastic fibers that are important in the wound healing process. In addition, estrogen causes the mobilization of circulating endothelial progenitor cells from the bone marrow. These cells assist in the creation and repair of the endothelium that has been destroyed or damaged (re-reendothelialization). Furthermore, estrogen also induces proliferation and migration and inhibit the apoptosis of progenitor cell.[21]

The males in this study, on average, spent more time in the hospital (>4 days) than the females. This finding is linked to the smoking habit, which is predominantly practiced by men and has

an adverse impact on wound healing. Smoking affects the tissue repair process by increasing elastase activity in the macrophages and prolonging the oxidant-antioxidant imbalance that contributes to tissue damage.[22] Puspita (2017) stated that smoking causes the death of post-operative tissue due to the decrease in blood flow. For instance, the occurrence of tissue closure and suppression of inflammatory response in the wound healing process, as well as the bacterial destruction mechanism that trigger the infection of operative wound. Smoking decelerates proliferation and collagen metabolism process and triggers dehiscence.[23]

There was a significant relationship between the type of appendicitis and the length of hospital stay post appendectomy. Perforated appendicitis required a longer hospital stay than acute appendicitis, because of the difference in the severity of inflammation. The study done by Mizar (2020) reported a significant difference in the length of hospital stay of inpatients between perforated appendicitis and acute appendicitis post appendectomy.[24]

Perforated appendicitis is one of the risk factors for a prolonged hospital stay. The condition causes a severe infection that requires a longer recovery time. With the severity of the infection and abdominal adhesions, the surgical time may be extended. Severe abdominal adhesions result in greater stress and local exudation during protracted dissection, hence extending postoperative recovery time.[16] Based on the result of this study, patients with perforated appendicitis were dominated by <4 days of hospital stay. This is related to aseptic precautions and appropriate care in order to reduce the incidence of surgical wound infection, resulting in a shorter hospital stay. Furthermore, the degree of the perforation in the form of microperforated appendicitis or free perforation appendicitis can have impact in the length of hospital stay. The more severe the appendicitis is, the longer patient must stay in the surgical treatment room of the hospital.[24]

This research showed no significant relationship between the duration of surgery and the length of hospital stay after an appendectomy. This finding, however, is not in accordance with the research by Zhang (2020), where their research reported a significant relationship in the length of hospital stay between the average of ≤3 days or >3 days and the duration of surgery (64.09 ± 17.24 minute vs 86.19 ± 39.96 minute, P < 0.01). Moreover, their study concluded that the duration of surgery was one of the risk factors for a prolonged hospital stay.[16]

The prolonged duration of surgery can be caused by the fatigue of the operating team and/or technical errors in the operating room. Longer surgery time often indicate complex surgical procedures.[25] The key success of acute appendicitis is the timely surgery after diagnosis.[16] There are other factors that determine the duration of surgical procedure, such as the characteristics of patients and the skills of the surgeon and surgical staffs.[25] The duration of a surgery performed a senior general surgeon (SGS) can be shorter than the surgery performed by a general surgery resident (GSR).[26] Preoperative planning can reduce the time used for decision making during the surgery and may help predict the needs during the surgery.[25]

A lengthy surgery is correlated with surgical site infection (SSI) incidence, which will also prolong the length of hospital stay. This research did not show a significant relationship between the duration of surgery and the length of hospital stay because the duration of the surgery did not only show the complexity of the surgical procedure, but also affected by the skill of the surgical team. Furthermore, there was no indication whether or not there was a delay in the operating room.[25]

This research showed a significant relationship between comorbidity and the length of hospital stay after an appendectomy. A shorter length of hospital stay can reduce the overall treatment cost and higher percentage of bed utilization.[16]

Comorbidity does not support wound healing process because of the lower oxygen and nutrition distribution, particularly in patients with diabetes mellitus whose blood glucose control is poor. The condition leads to cell dysfunctions that may inhibit wound healing process, especially hemostasis phase where the platelet derived growth factor (PDGF) is lower in the endothelial and epithelial cells. Consequently, there is a delay transition to inflammation phase. The increase in the number of wound-activated macrophages (WAM's) activated by the wound leads to the increased and prolonged inflammatory cytokine expressions. As a result, the inflammatory phase of wound healing becomes longer.[9]

Patients with comorbidity underwent longer hospital treatment, which was indicated by the longer hospital stay length. This is explainable because patients with underlying diseases require a higher intensity care than patients who were not presented with any comorbidity. Comorbidity may increase overall hospital expenses and prolonged the hospital stay in patients with acute appendicitis who received appendectomy intervention. Moreover, comorbidity increases the risk of morbidity and mortality. Cerebrovascular disease and diabetes mellitus are independent determinants of the increased cost and length of hospital stay after an open appendectomy.[27]

The effect of diabetes on SSI is found in an emergency appendectomy. Patients with diabetes have a higher risk of developing SSI. Diabetes is also found as the only significant factor that is associated with postoperative intra-abdominal abscess.[28]

Furthermore, a rigorous study regarding the LOS for patients who undergoes appendectomy including multi-medical service centers should be done in order to have more information and find an effective and efficient approach toward reducing LOS.

CONCLUSION

There were significant relationships between the following factors, such as age, type of appendicitis, comorbidity, and the length of hospital stay post open appendectomy procedure in Arun Lhokseumawe hospital, Aceh. There were no significant relationships between either age (p = 0.059) or the duration of surgery (p =0.052) and the length of hospital stay after an appendectomy.

CONFLICT OF INTEREST

The author declares no conflict of interest related to the material presented in this article.

ETHICS CONSIDERATION

Ethics approval has been obtained by the Health Research Ethics Committee Faculty of Medicine, University of Muhammadiyah Sumatera Utara with Ethical Approval Number: 729KEPK/FKUMSU/2021, before the study.

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AUTHOR CONTRIBUTION

All authors equally contribute to the study from the conceptual framework, data gathering, and data analysis until reporting the study result through publication.

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