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Profile of appendicitis patient: epidemiology, clinical, and laboratories evaluation in rural-urban area

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ABSTRACT

Appendicitis is one of the most common abdominal inflammations in daily emergency cases. The diagnosis of appendicitis is often delayed because the symptoms resemble other abdominal emergencies. The present research aimed to describe the clinical and epidemiological profile of acute appendicitis patients. The research design is a cohort retrospective study employing appendicitis patients' medical record data at PKU Muhammadiyah Hospital from January 1, 2016, to December 31, 2020. The variables obtained through the patient records were age, gender, domicile location, vital signs, physical examination, blood laboratory, ultrasound, histopathology, postoperative diagnosis, the incidence of peritonitis, and length of stay. The median age value in patients with appendicitis was 27 years (0-95), and the largest group was young adults (19-44 years). Abdominal pain was found in almost all research subjects. The median of leukocytes was 10.1 (3.32-65.80)×10^6/ml and the neutrophil-lymphocyte ratio (NLR) was 3.52 (0.47-30.57)/μl. The median percentage of the neutrophil count was 70.7 (27.90-94.81). The final diagnosis of complicated appendicitis was more than uncomplicated appendicitis (51.2% vs. 48.8%). We conclude that several detailed parameters, such as the location of abdominal pain, leukocyte count, and NLR can help the physician diagnose appendicitis and guide surgeons in deciding the type of surgery.

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1. INTRODUCTION

Appendicitis is an infection of the appendix, most often caused by an obstruction in the appendix [1]. Appendicitis is one of the most common abdominal inflammations in daily emergency cases [2], the estimated incidence of appendicitis at 86 cases per 100,000 people per year globally [3]. In Indonesia, the prevalence of acute appendicitis has been estimated at 95 cases per 1,000 population (0.05%) [4] and reaching 10 million annually. This number made Indonesia as the highest incidence of acute appendicitis in Southeast Asia [5]. Other recent data are scattered due to research location. A study revealed 503 appendicitis patients in 2012 at Dr. Hasan Sadikin General Hospital, Bandung, Indonesia [6]. Acute appendicitis is more common in men than women and is more prevalent in young adults [7]. The lifetime risk of appendicitis is 8.6% in men and 6.7% in women [8].

Clinically, the chief complaint of appendicitis is sometimes difficult to distinguish from other abdominal complaints. Appendicitis has a characteristic location of pain in the lower right abdomen [9], [10]. However, the patient often feels pain at a non-specific location and migrates to other abdominal regions. This condition challenges the physician to diagnose appendicitis immediately [11]. Several scoring tools can help to diagnose, but the accuracy is still inadequate [11]. Delay in making the diagnosis of appendicitis results in delays in treatment and increases the possibility of further complications [12].

Studies report there is an increase in the number of complicated appendicitis during COVID-19 [13], [14]. This increased number might be an effect of patient fear of COVID-19 and delay in looking for immediate treatment [15]. Complications can occur in the form of adhesions, perforation of the appendix, peritonitis, and sepsis, which can lead to death. Older patients (>40 years) are more likely to have false negatives result, increasing the risk of perforation and abscess [8], [16].

Appendectomy is still the best choice in managing appendicitis, either laparotomy or laparoscopically. Some cases of appendicitis can be treated with conservative management without surgery, especially in uncomplicated acute appendicitis [17], [18]. However, the number is tiny compared to cases requiring appendectomy. Several studies report changes in appendicitis management during the COVID-19 pandemic [17], [19]–[21]. Still, the results of the physical examination and investigations are essential for the surgeon to estimate the severity of appendicitis [2].

Data on appendicitis and its severity in developing countries have yet to be widely reported. Although areas in Asia and Africa are estimated to have a lower trend due to higher fiber consumption [2], limited access to health facilities can cause an increase in the severity of acute appendicitis cases [22]. There are no data on the prevalence and severity of appendicitis in Indonesia that are more recent than the previously mentioned, especially in Daerah Istimewa Yogyakarta (DIY).

Bantul is one of five regencies/cities in DIY Province, Indonesia. This regency can be categorized as a rural-urban area because half of the population lives in rural areas, farming is their daily occupation, and the other half already live in urban areas [23]. PKU Muhammadiyah Bantul Hospital, the place for this research, is more urban and closer to the government place. Hence, the patients vary between those who travel far from the rural area and those just around the hospital. The findings of this study would provide helpful decision-making information for physicians to determine the initial management in treating patients with appendicitis and distinguish it from other abdominal complaints by presenting these profiles of appendicitis patients.

2. RESEARCH METHOD

This retrospective cohort study used medical records of acute appendicitis patients. The subjects in this study were patients diagnosed with appendicitis, both based on clinical manifestation and histopathology, from January 2016 to December 2020. This study was conducted at PKU Muhammadiyah Bantul Hospital.

The search for medical records was carried out by entering the international classification of diseases 10th revision (ICD-10) code of appendicitis through electronic medical records and tracking the data of patients who undergo appendectomy from the hospital operating room register. The data collected are age, gender, address, patient complaints, vital signs, physical examination, other examinations (blood laboratory, ultrasound, and histopathology), postoperative diagnosis, the incidence of peritonitis, and length of stay. We analyzed the medical records and collected the data through an online research datasheet. The analysis did not include patient data that did not meet the inclusion and exclusion criteria.

A total 1,011 patients diagnosed with appendicitis from January 1, 2016, to December 31, 2020. The data was obtained using the ICD-10 code for appendicitis in electronic medical records and from the operating room register of patients who performed appendicectomy. The 748 medical record data have successfully been input into the research datasheet. From these data, 181 were duplicated, and 601 patient data met the inclusion and exclusion criteria for further analysis. Figure 1 shows a schematic data acquisition flow.

Data were processed and analyzed using the IBM-SPSS statistics version 25.0 software program. First, we performed a normality test using the Kolmogorov-Smirnov test on numerical data. The results were $p<0.05$ on all the data. It means that the data distribution is not normal; thus, the analysis data displayed is the median and range of each variable. The data were analyzed descriptively and presented in tables with explanations according to the research objective. This research has obtained permission from the Faculty of Medicine, Public Health, and Nursing ethics committee, Universitas Gadjah Mada (FK-KMK UGM), with ethical eligibility number: KE/0067/01/2021.

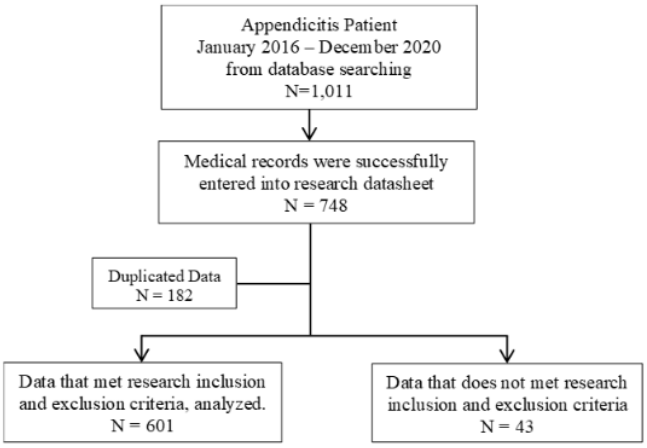

Figure 1. Data acquisition flow

3. RESULTS AND DISCUSSION

3.1. Subjects' characteristics

Table 1 shows the characteristics of the research subjects. The median age of appendicitis patients in this study was 27 years (0–95 years), and the highest percentage of subjects based on age group was young adults (19–44 years), with 261 subjects (43.5%). In this study, the number of female subjects (54.3%) was more than male subjects (45.7%). Fifty hundred and sixteen (86%) research subjects lived in the Bantul Regency.

In this retrospective cohort study, 601 appendicitis patients' data could be analyzed. The median age value in patients wi appendicitis was 27 years (0-95), and the largest group was young adults (19-44 years), as much as 43.4%. The results in this study are in line with the research made by Lima *et al*. [7] which also showed that the most age group with appendicitis was young adults (60.3%). Other studies have shown different results regarding the age group of appendicitis patients [13], [24], [25]. This result may be due to the different age groupings in each study.

This study shows more female subjects than male subjects (54.3% vs. 45.7%). This result is in line with the research conducted Zhafira *et al*. [6] which also showed that the female population was larger than the male population (52.1% vs. 47.9%). In comparison, other studies showed that male is more than female in appendicitis incidences [13], [14], [19], [26]. Of the subjects in this research, 85.9% lived in Bantul Regency in domicile characteristics. These results may be due to the geographical location of the research data collection hospital.

We analyzed the complaints of appendicitis patients. Almost all subjects (99.2%) complained of abdominal pain, and only five subjects denied any abdominal pain. Other complaints felt by the subjects were nausea (37%), vomiting (25.8%), fever (16.3%), and gastrointestinal problems such as diarrhea, constipation, bloating, and flatus difficulty (9.5%). The other complaints in this study are urinary tract disorders, weakness, headache, cough, shortness of breath, and others.

We tried to identify complaints in patients with appendicitis. Abdominal pain, fever, gastrointestinal complaints, and anorexia were included in the list of complaints included in the research datasheet. It was found that almost all research subjects had complaints of abdominal pain (99.2%); in line with other research, as many as 90% of subjects stated lower right abdominal pain [4], [25]. This study did not include more detailed data regarding the quality of abdominal pain or the location of abdomen pain. Other subjects' complaints obtained in this study were nausea (37%), vomiting (25.8%), fever (16.3%), digestive tract problems (diarrhea, constipation, bloating, and flatus difficulty) (9.5%), anorexia (3.3%), and other complaints (3.7%). Other prior studies also stated these complaints [3], [27]. One study reports another unusual complaint, such as scrotal pain and lower extremity edema in appendicitis, that needed additional diagnostic guidance [28]. Due to the width of complaints in appendicitis patients, physicians must be aware of these various possibilities to prevent delays in diagnosing appendicitis [3]. A more in-depth history and examination of some of these complaints can help the physician diagnose acute appendicitis and differentiate it from other abdominal complaints.

Table 1. Subjects' characteristics

Characteristic	Value
Age (years old) median (min-max)	27 (0–95)
Child (0–18) n=(%)	187 (31.1%)
Young adult (19–44) n=(%)	261 (43.4%)
Adult (45–64) n=(%)	133 (22.1%)
Elderly (>65) n=(%)	20 (3.3%)
Sex n=(%)	
Male	274 (45.6%)
Female	327 (54.4%)
Domiciled area n=(%)	
Bantul	516 (85.9%)
Outside Bantul Region (DIY)	70 (11.6%)
Outside DIY Province	15 (2.5%)
Patient's complaints n=(%)	
Abdominal pain	596 (99.2%)
Fever	99 (16.5%)
Nausea	223 (37.1%)
Vomiting	156 (26%)
Gastrointestinal problems (diarrhea, constipation, flatus difficulty, and bloating)	57 (9.5%)
Anorexia	20 (3.3%)
Other complaints	22 (3.7%)
Vital sign, median (min-max)	
Blood pressure (mmHg) n=574	
Systolic blood pressure	115 (70–201)
Diastolic blood pressure	71 (20–123)
Heart rate (x/minute) n=600	83 (40–150)
Respiration rate (x/minute) n=597	20 (15–32)
Body temperature (celsius degree) n=597	36.6 (35.0–40.0)
Visual Analogue Scale (VAS) n=470, median (min–max)	4 (0–8)
Alvarado score n=601, median (min–max)	4 (0–9)
Peritonitis, n=(%)	
Yes	96 (16%)
No	456 (75.9%)
No data	49 (8.2%)
Medical procedure, n=(%)	
Appendectomy	266 (44.3%)
Laparoscopy	27 (4.5%)
Laparotomy	205 (34.1%)
Conservative (no surgery)	2 (0.3%)
No data	101 (16.8%)
Diagnosis, n=(%)	
Uncomplicated appendicitis	293 (48.8%)
Complicated appendicitis	308 (51.2%)
Length of stay (days) median (min-max)	4 (0–31)

3.2. Laboratory finding

Table 2 shows the laboratory values in appendicitis patients in this study. The research subjects' hemoglobin results showed a median value of 13.31 g/dl (7–38.10 g/dl) and a median hematocrit value of 39.50% (6.20–54.20%). The results of the leukocyte examination showed a median value of 10.1×106/ml (3.32–65.80×10^6/ml). The erythrocytes and platelets examination results had median values of 4.7×109/ml and 287.2×10^6/ml, respectively.

The percentage of neutrophils had a median of 70.7% (27.90–94.81%). The median of lymphocytes was 20.3% (2.85–58.90%). The median of monocytes was 5.87% (0.50–14.49%). The median of eosinophils was 1.40% (0.00–19.60%). Lastly, the median of basophils is 0.30% (0.00–4.90%). The neutrophil-lymphocyte ratio (NLR) median is 3.52 (0.47–30.57). The platelet-lymphocyte ratio (PLR) median is 1.49 (0.18–9.74). The median of the lymphocyte-monocyte ratio (LMR) is 3.41 (0.31–21.44).

Several relevant laboratory tests can help establish the diagnosis of acute appendicitis. Complete blood count, C-reactive protein (CRP), routine urine examination, and pp test for women can be done for diagnosis [3], [29] leukocyte count and NLR are significant parameters for diagnosing acute appendicitis [30]–[32]. The leukocyte count can show us the inflammatory process quantitatively and is often accompanied by increased body temperature [8]. In this study, the median of leukocytes was 10.1 (3.32–65.80)×10^6/ml, and the NLR was 3.52 (0.47–30.57)/μl. This result is quite similar to the cut-off value proposed by Shashirekha *et al*. 11.900/mm3 for leukocyte count and 3.0 for NLR [30]. Moreover, NLR can predict appendix perforation with a cut-off of 8.96 [33].

The leukocyte count or NLR alone, is insufficient to diagnose appendicitis without considering their parameters due to a lack of clinical accuracy and specificity [12]. In one study, with a leukocyte count of less

than 10,000 per microliter, 20% of the population was still diagnosed with acute appendicitis. An observational study conducted by Andersson *et al*. [34] showed an accuracy of 0.85 when acute appendicitis was established based on clinical and laboratory parameters (body temperature, leukocyte count, CRP, polymorphonuclear (PMN) count, and PMN ratio).

In this study, the median percentage of the neutrophil count was 70.7 (27.90–94.8 7 These results are quite in line with several studies which state that an increase in PMN of more than 7–7.5 has a sensitivity of 71–89% and a specificity of 48–80% in diagnosing acute appendicitis. The proportion of PMN of more than 75% can predict acute appendicitis [12]. Increased NLR and decreased lymphocyte percentage in acute appendicitis cases can be used as additional diagnostic markers [35]–[37]. Moreover, NLR and platelet count (PLT) can help predict patients with complicated acute appendicitis [38].

Table 2. Laboratory examination result

Laboratory parameters, n=601	Value, median (min-max)
Haemoglobin (g/dl)	13.31 (7.00–38.10)
Haematocrit (%)	39.50 (6.20–54.20)
Leukocyte (x 10^6/ml)	10.1 (3.32–65.80)
Erythrocytes (x 10^9/ml)	4.7 (2.8–20.9)
Platelets (x 10^6/ml)	287.2 (7.5–802.0)
Neutrophils (%)	70.7 (27.90–94.81)
Lymphocyte (%)	20.30 (2.85–58.90)
Monocyte (%)	5.87 (0.50–14.49)
Eosinophil (%)	1.40 (0.00–19.60)
Basophil (%)	0.30 (0.00–4.90)
Absolute neutrophil (/µl)	693.16 (134.32–4606.00)
Absolute lymphocyte (/µl)	198.24 (15.38–1579.20)
Absolute monocyte (/µl)	57.37 (2.34–383.68)
Absolute eosinophil (/µl)	16.65 (0.00–207.76)
Absolute basophil (/µl)	2.61 (0.00–63.36)
NLR	3.52 (0.47–30.57)
PLR	1.49 (0.18–9.74)
LMR	3.41 (0.31–21.44)

3.3. Ultrasonography and histopathology result

Table 3 shows the results of the ultrasound and histopathology examination. Ultrasound examination was performed in more than half of appendicitis patients. The ultrasound results were 173 (28.8%) subjects with acute appendicitis, 153 (25.5%) subjects who came out with appendix not being visualized, 10 (1.7%) subjects with chronic appendicitis, 6 (1%) subjects with suspected appendicitis, 1 (0.2%) subject received normal ultrasound results. The remaining subjects, 257 (42.8%), did not undergo ultrasound examination.

Histopathological examinations were only performed on less than half of the research subjects. In subjects with histopathological examination results, chronic appendicitis with acute exacerbation was the most common result, with 89 subjects (14.8%). Followed by acute appendicitis et peri appendicular infiltrates in 39 subjects (6.5%) and chronic appendicitis with acute exacerbations et peri appendicular infiltrates in 27 subjects (4.5%). Subjects diagnosed with acute appendicitis and acute perforated appendicitis had the same percentage of 2.8% of the total subjects, equal to 17 subjects. Last, two subjects had chronic appendicitis obliterans (0.3%).

Ultrasound, computed tomography scan (CT scan), and magnetic resonance imaging (MRI) are options for 7 aluating patients with suspected appendicitis. Ultrasound is the most frequently used modality to confirm the diagnosis of appendicitis. It has a high sensitivity of 71–85% and a specificity of up to 97% [3], [12]. Ultrasound is also the least expensive and non-invasive imaging modality [8]. Combining laboratory results and other examinations, such as history taking/physical examination or ultrasound/CT scan, is an excellent way to establish an acute appendicitis diagnosis [39].

The ultrasound examination was performed on 343 research subjects. From the results of these examinations, as many as 173 subjects with ultrasound results of acute appendicitis, and 153 subjects had ultrasound results of the appendix not visualized. These results align with research conducted by D'Souza *et al*. [40] that 45% of ultrasound results cannot show the condition of the appendix. Obesity, anatomical variations, and overlapping with abdomen gases cause the appendix not to visualize properly. However, if the appendix can be visualized using ultrasound, the negative appendicectomy rate (NAR) will decrease from 55–18.3%.

Table 3. Ultrasonography (USG) and histopathology result

Examination results	Value, n (%)
USG	
Normal	1 (0.2%)
Acute appendicitis	173 (28.8%)
Chronic appendicitis	10 (1.7%)
Not visualized appendix	153 (25.5%)
Suspect appendicitis	6 (1%)
Not underwent USG	258 (42.9%)
Histopathology	
Acute appendicitis	16 (2.7%)
Acute appendicitis et peri appendicular infiltrate	39 (6.5%)
Perforated acute appendicitis	17 (2.8%)
Chronic appendicitis with acute exacerbation	89 (14.8%)
Chronic appendicitis with acute exacerbation et peri appendicular infiltrate	27 (4.5%)
Chronic appendicitis obliterans	2 (0.3%)
Not undergo histopathology examination	411 (68.2%)

3.4. The severity on appendicitis

Postoperative diagnoses in this study were 293 (48.8%) uncomplicated appendicitis, and 308 (51.2%) subjects were complicated appendicitis. The most frequently performed procedures for appendicitis patients were appendectomy (44.2%), followed by laparotomy appendectomy (34.2%), and laparoscopy (4.5%). A total of 2 (0.3%) subjects did not have the appendix removed. There were 96 (16%) subjects with peritonitis. The length of stay for appendicitis patients in this study had a median of four days (0–31 days). These data are shown in Table 1.

The final diagnosis of complicated appendicitis was more than uncomplicated appendicitis (51.2% vs. 48.8%). This result is similar to a study that showed a 59.67% result of complicated appendicitis [15], [22]. This can be caused by various factors, such as limited access to health facilities, examination delays, and logistical problems when referring patients [41]. Other than that, the fear of COVID-19 is one of the reasons why the diagnosis was delayed during the pandemic [15]. Complicated appendicitis increased during the COVID-19 pandemic [42], [43]. In addition, delays due to health-seeking behavior make it difficult for clinicians to determine the subsequent treatment/action. Research by Kong *et al*. [41] explained that the delay had approximately five days from the patient's first complaint. Delay in diagnosing appendicitis can cause appendix complications into perforation, abscess formation, sepsis, and intra-abdominal adhesions [44].

In this study, 96 subjects (16%) were diagnosed with peritonitis caused by appendicitis. This result is similar to a study by Gudi *et al*. [45] that found 13% of patients with peritonitis. Peritonitis is an inflammation in the peritoneum caused by several factors; bacteria are the most common. Other causes can be chemical, biliary, tuberculous, chlamydial, and drug-induced. Peritonitis caused by bacteria comes from various site infections: direct invasion, translocation, circulation, or female genital tract. Peritonitis caused by appendicitis is categorized as translocation because it moved from the gangrene appendix or perforated one [46]. Appendicitis in children is more likely to develop into peritonitis than in adults. In a study by Bhuiyan [47] the prevalence of peritonitis caused by perforated appendicitis was up to 42.25% in children younger than 18 years old.

4. CONCLUSION

Appendicitis patient profiles can vary, although there is much literature regarding the typical signs and symptoms. A physician must understand the examination thoroughly and consider various examination results immediately to establish the diagnosis of appendicitis. Several additional, more detailed parameters, such as the location of abdominal pain, leukocyte count, and NLR, can assist clinically in establishing the diagnosis of appendicitis and support the surgeon in deciding the surgery type.

This research also had various kinds of shortcomings and obstacles. Research using secondary data has problems obtaining incomplete data and not meeting the research team's desired parameters. We often found incomplete data during the medical record analysis, such as uncompleted anamnesis or missing examination results. This causes some subjects' data not to be analyzed due to insufficient data. More detailed research and using different methods can be carried out in the future to provide better and statistically meaningful data output.

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