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The Correlation between Alvarado Score and Histopathological Profile of Appendicitis in Academic Hospital of Universitas Gadjah Mada

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ABSTRACT

Introduction: Appendicitis is an inflammation of the appendix vermiformis, which is the most common cause of acute abdominal emergency and requires immediate surgical treatment. Anamnesis and clinical examinations in Alvarado score results can be used as early detection to determine further treatment. The use of histopathological examination is to confirm the diagnosis of appendicitis. This study was to determine the correlation between the Alvarado score and the histopathological profile of appendicitis. It assesses appendicitis diagnosis accuracy based on the Alvarado score at the Academic Hospital of UGM.

Materials and Methods: This study was a cross-sectional design study with a diagnostic test method using secondary data from 173 appendicitis patients from January 1 to December 31 2019, who met the inclusion and exclusion criteria.

Results: According to the histopathology result, the finding of acute appendicitis was 95.95%, which Alvarado's score of ≥7 was 71.68%. The overall sensitivity, specificity, accuracy, positive predictive value, and negative predictive value of Alvarado score for acute appendicitis were 73.49%, 71.43%, 73.41%, 98.39 %, 10.20%, respectively.

Conclusion: The Alvarado score is a sensitive, specific, and accurate scoring system that functions as a diagnostic tool for acute appendicitis.

Keywords: *Alvarado score, Diagnostic tool of acute appendicitis, Histopathological profile of appendicitis, Sensitivity and Specificity*

1. Introduction

Acute appendicitis is one of the causes of acute abdominal emergencies that require immediate surgery. The incidence of appendicitis in North America is 100 per 100,000 people, with the number of cases in 2015 was 378,614.[1]. The latest epidemiological data of appendicitis in Indonesia is still unclear. According to the Ministry of Health of the Republic of Indonesia in 2009, the report showed 621,435 patients with appendicitis with a percentage of 3.53%.[2]

Appendicitis is an inflammatory process in the vermiform appendix that can occur at any age but is rarely occurs in late adulthood and infancy. The incidence of appendicitis increases in adolescents and adults.[3] Research conducted at Sanglah Hospital Denpasar showed that cases of appendicitis were found in 723 samples during 2015-2017.[4]

The cause of appendicitis is a blockage in the lumen of the appendix, which can be caused by the accumulation of hard feces (fecalith), lymphoid hyperplasia, parasites, tumors, malignancies, and bacteria such as Escherichia coli (76%), Enterococcus (30%), Bacteroides (24 %) and Pseudomonas (20%). Blockage of the appendix can result in fluid accumulation in the lumen. It makes resulting in an increase in intraluminal pressure and rapid dilatation due to its small capacity.[5]

The infection causes inflammation that can extend to the serosa, parietal peritoneum, and other adjacent organs. The inflammation

stimulates afferent nerve endings from T8-T10, producing pain in the epigastric and periumbilical regions. Moreover, the pain will usually shift and then settle in the right lower quadrant. If the condition continues, the blood flow to the arteries will be disrupted, which can cause infarction. If the condition continues, it will cause gangrene and perforation, which usually occur between 24 and 36 hours.[5]

Appendicitis which is not treated immediately, can cause several complications such as sepsis and even cause death.[1,6] Anamnesis, clinical examination, and other investigations are very important to get the right diagnosis in appendicitis patients. Several scoring systems have been developed to help diagnose acute appendicitis, one of which is the Alvarado scoring system. The Alvarado score is a simple, non-invasive diagnostic method that can guide doctors in establishing the diagnosis of appendicitis and its subsequent management.[6,7]

Patients with clinical appendicitis who require surgery will be subjected to a histopathological examination at the Anatomical Pathology Laboratory at the UGM Academic Hospital. A definitive diagnosis of appendicitis can only be obtained from the results of histopathological examination. The available data can help assess the accuracy of the diagnosis of appendicitis based on the Alvarado score.

Table 1. Alvarado Score

	Component	Score
Symptoms	Migration of pain from epigastric to the right lower quadrant	1
	Anorexia	1
	Nausea/vomiting	1
Signs	Tenderness in the right lower quadrant	2
	Rebound pain	1
	Elevation of temperature (above 37.5°C)	1
Laboratory	Leukocytosis >10.000 cel/mm^3	2
	Shift to the left (percentage of neutrophil >75%)	1

The interpretation of Alvarado score is in the following: Score 5-6: The possibility of appendicitis (*compatible*); Score 7-8: Most likely appendicitis (*probable*); Score 9-10: Definitely appendicitis (*very probable*); Score Alvarado recommends surgery on all patients with a score of ≥7 and re-observation every four or six hours for patients with a score of 5 or 6. Other diseases are possible if the score is <5. 6,7,8

2. Methods

This study used a diagnostic test method with a cross-sectional research design. It was carried out at the Anatomical Pathology Laboratory Unit at the UGM Academic Hospital Yogyakarta from August to October 2020. The population of this study was all patients with clinical appendicitis who underwent surgery and histopathological examination at the Anatomical Pathology Laboratory Unit at the UGM Academic Hospital from January 1, 2019 – to December 31, 2019.

The sample is taken from the total population that meets the inclusion and exclusion criteria. Inclusion criteria including:

a. Patients with a diagnosis of appendicitis who have had an appendectomy.

b. Patients whose appendectomy specimens were histopathologically examined.

c. Patients with complete medical records such as age, gender, history, clinical examination, and supporting examinations so that Alvarado scoring can be done.

While the exclusion criteria are a patient suspected of appendicitis with other intraoperative diagnoses.

Alvarado score (independent variable) is a scoring system for assessing patients with appendicitis (related to table 1). It is positive if the total score is ≥7 and negative if the total score is <7. The histopathological profile of appendicitis (bound variable) is the result of microscopic examination of the appendix organ/tissue was performed by appendectomy. Moreover, it was sent to the anatomical pathology laboratory unit to be assessed by an anatomical pathologist and used as a confirmation of the diagnosis. It means to be positive if microscopic examination of the appendix tissue with acute appendicitis is obtained. On the other hand, it means negative if the microscopic examination results other than acute appendicitis.

Data analysis used was a diagnostic test to obtain sensitivity, specificity, positive and negative predictive value. Also, it was used to find out the accuracy of the Alvarado score results with the histopathological profile of appendectomy specimens.

The research collected secondary data from the patient's medical record file. Moreover, the use of medical records considered the code of ethics, namely confidentiality. It meant that the patient's identity, including the name, medical record number, address, and code number for the histopathology examination, would not be written in this research.

This research has obtained permission from the Research Ethics Commission of the Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, with ethical eligibility Number: KE/FK/1015/EC/2020 dated September 11, 2020.

3. Results

The number of cases of appendicitis at the UGM Academic Hospital in 2019 was 285 cases, with a total of 258 cases of acute appendicitis (90.53%) and 27 cases of non-acute appendicitis (9.47%). Women (51.58%) had slightly more exposed appendicitis than men (48.42%). The highest prevalence of cases was in women aged 17-25 years (Figure 1). From the total prevalence of 285 cases, a sample of 173 patients met the inclusion and exclusion criteria.

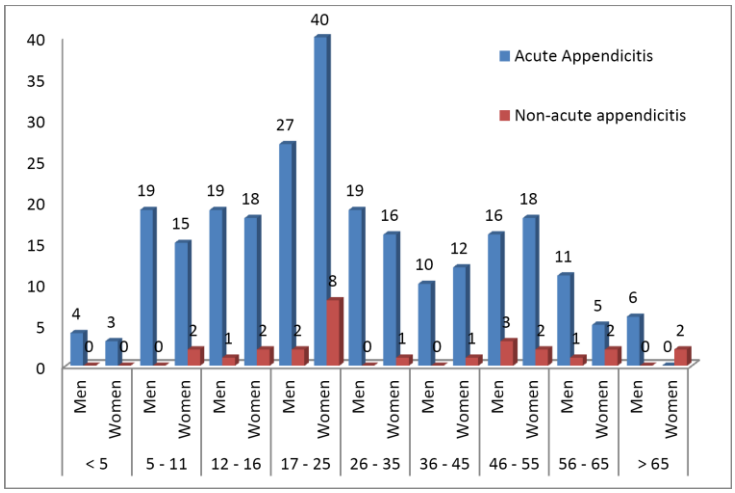

Figure 1. Appendicitis Prevalence at UGM Academic Hospital in 2019 by Gender and Age

Table 2. Characteristics of Research Subjects

No	Variable	Category	Total	Percentage
1	Age (year)	Toddler (<5 th)	8	4,62%
		Children (5-11 th)	29	16,76%
		Early Adolescent (12-16 th)	25	14,45%
		Late Adolescent (17-25 th)	36	20,81%
		Early Adult (26-35 th)	22	12,72%
		Late Adult (36-45 th)	15	8,67%
		Early Elderly (46-55 th)	25	14,45%
		Late Elderly (56-65 th)	11	6,36%
		Very old Elderly (>65 th)	2	1,16%
2	Gender	Men	89	51,45%
		Women	84	48,55%
3	Alvarado Score	< 7	49	28,32%
		≥7	124	71,68%
4.	HistopathologicalResult	Acute Aopendicitis	166	95,95%
		Non-Acute Appendicitis	7	4,05%
	Total		173	100%

The average age was 27.10 years. Alvarado's average score was 6.84. Moreover, there were 124 cases (71.68%) of patients with an Alvarado score ≥7. Meanwhile, there were 49 cases (28.32%) of patients with Alvarado score <7 consisting of 17 patients with Alvarado score <5 and 32 patients with Alvarado score 5-6.

Table 3. Diagnostic Test of Alvarado Score on Appendicitis Patient

Histopathological Profile of Appendicitis				
		Positive (Acute Appendicitis)	Negative (Non-acute appendicitis	Total
Alvarado Score	Positive (≥7)	122 True positive	2 False Positive	124
	Negative (<7)	44 False Negative	5 True Negative	
	Total	166	7	173
	sensitivity	73,49%		
	specificity	71,43%		
Positive predictive value		98,39%		
Negative predictive value		10,20%		
accuracy		73,41%		

Table 4. Diagnostic Test of Alvarado Score in Appendicitis Patients by Gender

No	Gender	Alvarado Score	Total of Patients	Histopathological Result		Sensitivity (%)	Specificity (%)	Positive Predict Value (%)	Negative Predict Value (%)	Accuracy (%)
				Acute Appendicitis	Non-Acute Appendicitis					
1	Men	≥7	67	65	2	75,58	33,33	97,01	4,55	74,16
		<7	22	21	1					
2	Women	≥7	57	57	0	71,25	100	100	85,19	72,62
		<7	27	23	4					
	Total	≥7	124	122	2	73,49	71,43	98,39	10,20	73,41
		<7	49	44	5					

4. Discussion

The prevalence of appendicitis at the UGM Academic Hospital in 2019 was 285 cases. The number of cases of acute appendicitis (90.53%) was higher than the number of cases of non-acute appendicitis (9.47%). The frequency of appendicitis in men and women was generally the same, but the research found that the incidence of appendicitis was slightly more in women (51.58%) than in men (48.42%). It is similar to the study in RSU Kota Tangerang Selatan, where the distribution of appendicitis patients was more in women (57.7%) than men (42.3%).[9]

In Figure 2, the highest prevalence of appendicitis was found in the group of late adolescents aged 17-25 years. There were 77 cases (27.02%) where women had a higher percentage (16.84%) than men (10.18%). In comparison, the lowest prevalence of appendicitis cases was in the group of children under 5 years, which only found 7 cases (2.46%). It is similar to the study in RSUP Sanglah Denpasar, with the most cases of appendicitis in the 17-25 year with the percentage of 29.3%.[4] In RSU Kota Tangerang Selatan, the highest case of appendicitis was in the 17–25-year age group.[9] On the other hand, study in RSUP Prof. Dr. R.D. Kandou Manado found that the highest case was at the age of 20-29 years.[10] It can be caused due to the peak of the growth of lymphoid tissue during adolescence. It makes hyperplasia of the lymphoid glands cause a blockage and increased intraluminal pressure, which will develop into inflammation of the appendix.[11]

There were 78 cases with uncomplete medical records and 34 cases with other intraoperative diagnoses excluded from 285 cases of appendicitis so that the number of patients analyzed was 173 cases. In table 2, it was found that there were more cases of acute appendicitis (95.95%) than non-acute appendicitis (4.05%). Patients with histopathological examination of acute appendicitis were 166 patients from 173 samples (95.95%), consisting of 42 patients with acute suppurative appendicitis and 124 patients with acute exacerbation of chronic appendicitis. Meanwhile, the results of non-acute appendicitis examination were 7 patients from 173 samples (4.05%), consisting of 2 cases of appendicitis obliterans, 4 cases of chronic appendicitis, and 1 case of mucocele with mucinous hyperplasia of the appendix mucosa. Chronic appendicitis is usually caused by a blockage in the appendix due to hard feces (fecalith), infection, tumors such as mucocele, lymphoid gland hyperplasia, or obliteration of the lumen of appendix that occurs in appendicitis obliterans.[5]

In the sample of this study (Table 2), there were more men (51.45%) than women (48.55%). The result was in line with the research in RSUP Sanglah Denpasar, with the distribution of appendicitis patients in men (54.9%) more than women (45.1%).[4] In addition, the study in RSUP Prof. Dr. R.D. Kandou Manado also reported that the incidence of appendicitis in men was more often affected by acute appendicitis than women.[10] It is hypothesized because of the life style and dietary habit of men. They spend more time outside the home and are more likely to consume fast food and less fibre. It may cause a functional blockage in the appendix and the growth of microbes that trigger inflammation in the appendix. One of the problems in the digestive system is appendicitis.[4,10,12,13]

The most frequent cases were in the late adolescent 17-25-year-old group, with a percentage of 20.81%. On the other hand, the lowest case was in the very old elderly (>65 years) with a percentage of 1.16%. It was similar to the research in RSUP Sanglah Denpasar and RSU Kota Tangerang Selatan.[4,9] They stated that the causes are a decrease in the amount of lymphoid tissue in the appendix and changes in the mucous and serous layers elasticity. It causes the stretching ability in response to intraluminal pressure to decreases.[14]

The characteristics of the subjects in this study were analyzed based on the Alvarado score. The results showed that patients with an Alvarado score of ≥7 (71.68%) were more than Alvarado scores <7 (28.32%). It is similar to the research in India, where the patients with Alvarado score of ≥7 (78.99%) was more than Alvarado score <7 (21.01%).[15]

Based on the histopathological examination, it was found that there were more patients with acute appendicitis (95.95%) than non-acute appendicitis (4.05%). It is in line with RSUD Tangerang Selatan's study, where patients with histopathological results in acute appendicitis (76%) were more than patients with non-acute appendicitis (24%).[16] The same result was also reported in Kayseri Turkey, where patients with histopathological results in acute appendicitis (73%) were more than patients with non-acute appendicitis (27%).[17]

The research results found that sensitivity, specificity, positive predictive value, negative predictive value, and accuracy value for Alvarado's score were 73.49%, 71.43%, 98.39%, 10.20%, and 73.41%, respectively. First, it is similar to research in Ankara Turkey.[18] The results of sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of 86.2%, 59.0%, 83.9%, 63.1%, and 78.3% were reported.[18] Second, these results are also almost the same as the research in Kayseri Turkey.[17] The results were shown with sensitivity, specificity, positive predictive value, negative predictive value, and accuracy, respectively 54%, 73.3%, 88.2%, 29.7%, and 57.7%.[17] Third, research in India had similar results reported the value of sensitivity, specificity, positive predictive value, and negative predictive value respectively of 87.80%, 38.10%, 73.50%, and 61.50%.[6] In addition, researched in India from November 2011 to October 2013 and had similar results.[15] The results of the sensitivity, specificity, positive predictive value, and negative predictive value, respectively, were 92.79%, 77.77%, 94.49%, and 72.14%.[15]

Based on Table 4, it was reported that the sensitivity and accuracy in men (75.58% and 74.16%) were higher than in women (71.25% and 72.62%). The study is similar to the research Saudia Arabia and India which obtained higher sensitivity and accuracy values in men.[26,27]

The limitation of the data obtained from medical records stated that there was a history of treatment, both antipyretic and previous antibiotics, that could bias the Alvarado score results. It is especially on clinical signs in the form of an increase in body temperature (fever with a temperature > 37.5°C) and laboratory examination scores in the form of leukocytosis (>10,000 cells/mm3) and neutrophil shift (>75%).

5. Conclusion

Alvarado score is a scoring system that is sensitive, specific, and accurate. It can be used as a diagnostic tool for acute appendicitis. The

Alvarado score is sensitive to both age and sex groups. It is recommended for further research to conduct it with a larger sample, a longer time, and the age grouping of children with Pediatric appendicitis score and adults with Alvarado score to be more representative.

References

1. Mollie F, Samuel Q, Belle SK, Natalie M, Chad GB, Greg WC, Nij B, Subrata G, Elijah D, Siew N, Gilaad G. The Global Incidence of Appendicitis: A Systematic Review of Population-based Studies. Ann Surg, 2017; 266: 237–241.
2. Kementerian Kesehatan Republik Indonesia. Profil Kesehatan Indonesia. Jakarta: Departemen Kesehatan, 2009.
3. Muttaqin A, Sari K. Gangguan Gastrointestinal: Aplikasi Asuhan Keperawatan Medikal Bedah, Salemba Medika, Jakarta, 2011.
4. Cathleya F, Gotra, Mahastuti. Karakteristik Pasien dengan Gambaran Histopatologi Apendisitis Di RSUP Sanglah Denpasar Tahun 2015 – 2017. *Jurnal Medika Udayana*, 2019; Vol. 8 No.7.
5. Petroianu A, Barroso TVV. Pathophysiology of Acute Appendicitis. JSM Gastroenterology and Hepatology, 2016; 4(3).
6. Nirmala, Mysore J, Shahanuma S, Rajendra N. Evaluation of the Diagnostic Accuracy of Modified Alvarado Scoring System in Comparison to Histopathological Results in Acute Appendicitis. Annals of Pathology and Laboratory Medicine, 2018; Vol. 5, Issue 1.
7. RajaShekar J, Uday MM, Naveen N. Modified Alvarado Score and its Application in the Diagnosis of Acute Appendicitis. International Journal of Contemporary Medical Research, *2016;* Volume 3, Issue 5.
8. Alvarado, A. A practical score for the early diagnosis of acute appendicitis. Annals of Emergency Medicine, 1986; 15(5): 557-564.
9. Amalia I. Gambaran sosio-demografi dan gejala apendisitis akut di RSU Kota Tangerang Selatan. Universitas Islam Negeri Syarif Hidayatullah, Jakarta, 2016.
10. Thomas GA, Lahunduitan I, Tangkilisan A. 2016. Angka kejadian apendisitis di RSUP Prof. Dr, R. D. Kandou Manado periode Oktober 2012 – September 2015. Jurnal *e*-clinic, 2016; 4(1):1-16.
11. Craig S. Appendicitis treatment & management. Medscape, 2017.
12. **12.** Indri U, Karim D, Elita V. 2014. Hubungan Antara Nyeri, Kecemasan Dan Lingkungan Dengan Kualitas Tidur Pada Pasien Post Operasi Apendisitis. Program Studi Ilmu Keperawatan, Universitas Riau.
13. Sima F, Haskas Y, Darwis D. Faktor Risiko Kejadian Apendisitis Di Rumah Sakit Umum Daerah Kab. Pangkep Stikes Nani Hasanuddin Makassar, 2013.
14. Garba S, Ahmed A. Appendicitis in the Elderly. Intechopen, 2010; 1: 109.
15. Sonawane RS, Jatkar GL, Chaudari MS. Correlation of Alvarado score for acute appendicitis with pathological acute appendicitis. International Surgery Journal. 2016; Vol 3: Issue 3.
16. Ramadhanti A. Uji Sensitivitas dan Spesifisitas Skor Alvarado terhadap Kajadian Apendisitis Akut di RSUD Tangerang Selatan Tahun 2015-1026. Universitas Islam Negeri Syarif Hidayatullah, Jakarta, 2018.

17. Ozkan S, Dukan A, Durukan P, Yildirim A, Ozbakan O. The accuracy rate of Alvarado score, ultrasonography, and computerized tomography scan in the diagnosis of acute appendicitis in our center. Nigerian Journal of Clinical Practice, 2014; Vol 17 Issue 4.
18. Aydin S, Fatihoglu E, Ramadan H, Akhan B, Koseoglu E. Alvarado Score, Ultrasound, and CRP: How to Combine Them for the Most Accurate Acute Appendicitis Diagnosis. Iran J Radiol, 2017; 14(2): e38160.
19. Al-Hashemy AM, Selem MI. Appraisal of the modified Alvarado score for acute appendicitis in adults. Saudi Med J, 2004; 25: 1229-31.
20. Shrivastava UK, Gupta A, Sharma D. 2004. Evaluation of the Alvarado score in the diagnosis of acute appendicitis. Trop Gastroenterol, 2004; 25: 184-6.