RESEARCH ARTICLE OPEN ACCESS

Manuscript received November 5, 2022; revised November 20, 2022; accepted January 20, 2023; date of publication February 25, 2023
Digital Object Identifier (**DOI**): https://doi.org/10.35882/ijahst.v3i1.190

How to cite: Devan Andhika, Anik Handayati, and Evy Diah Woelansari, "Diagnostic Test Fine Needle Aspiration Biopsy (FNAB) Examination On Gold Standart Histopathological Tests For Identification Of Colli Lympadynopathy Patients At Rspal. Dr. Ramelan Surabaya", International Journal of Advanced Health Science and Technology, vol. 3, no. 1, pp. 7–14, February. 2023.

Diagnostic Test Fine Needle Aspiration Biopsy (FNAB) Examination on Gold Standard Histopathological Tests for Identification of Colli Lymphadenopathy Patients at RSPAL. Dr. Ramelan Surabaya

Devan Andhika Putra Pratama[1], Anik Handayati[1], and Evy Diah Woelansari[1]
[1]Medical Laboratory Technology, Polytechnic of Health Surabaya, SUB 60286, Indonesia
Corresponding author: Anik Handayati (e-mail: anik_handayati@yahoo.co.id).

"This work was supported in part by Department of Medical Laboratory Technology, Health Polytechnic Ministry of Health Surabaya"

ABSTRACT Lymphadenopathy is a common clinical manifestation which requires rapid and accurate diagnosis. Fine Needle Aspiration Biopsy (FNAB) is used as an initial and direct diagnosis in cases of lymphadenopathy, confirmatory diagnosis of colli lymphadenopathy is carried out by histopathological examination. The purpose of this study was to determine the value of the FNAB diagnostic test for lymphadenopathy colli FNAB against the gold standard histopathology of Paraffin Blok for benign and malignant lymphadenopathy, examination data for Colli Lymphadenopathy obtained at RSPAL has never been studied before. This type of research is observational descriptive by taking medical record data (SIM-RS) of patients with lymphadenopathy in the colli region who were examined for FNAB and histopathology at the Anatomical Pathology Laboratory Installation, RSPAL dr. Ramelan Surabaya for the period January 2019 – March 2022. The sample used was selected using the total sampling method, obtained as many as 66 samples that met the inclusion criteria. The results of the FNAB examination were then matched against the histopathological gold standard examination data. Furthermore, the data was processed by 2x2 crosstabulation and diagnostic tests were carried out to determine the sensitivity, specificity, positive predictive value, negative predictive value, and accuracy. The results showed that the accuracy of the FNAB diagnostic test was 86.56%, sensitivity 80.48%, specificity 96.15%, positive predictive value 97.05%, negative predictive value 75.75%. In general, it can be stated that the FNAB examination can be a screening diagnostic tool that is easy, fast, relatively affordable and applicable in helping to establish the diagnosis of colli lymphadenopathy.

INDEX TERMS Colli Lymphadenopathy, *Fine Needle Aspiration Biopsy* (FNAB), Diagnostic test, Histopathology

I. INTRODUCTION

Lymphadenopathy is a condition of enlarged lymph nodes with a size greater than 1 cm [1][2]. The human body has about 500 to 600 lymph nodes, with the most being found in the axillae, groin, neck, chest, and abdomen. The cause of lymphadenopathy in the neck is due to inflammation, infection (viruses, bacteria, and protozoa), and neoplastic. Incidence of benign lymphadenopathy includes normal, inflammatory, infectious, reactive, and tuberculous lymphadenopathy. Malignant lymphadenopathy includes metastases and lymphomas [3]. Lymphadenopathy is a clinical manifestation of regional or systemic disease, and serves as an excellent indication of the etiology and incident pathology of the underlying disease [4]. Lymphadenopathy is a common clinical manifestation and requires a rapid and accurate diagnosis so that appropriate treatment protocols can be started as early as possible [4][5].

Regional Colli masses or masses in the neck are a frequent clinical finding in lymphadenopathy. Masses in the neck can occur in patients of any age group. Evaluation of a patient with a neck mass should begin with a careful and complete history and a thorough head and neck examination. The clinical diagnosis of palpable lymphadenopathy is very important and special to distinguish between inflammatory lesions or primary or metastatic neoplastic tumors [6]. Fine needle aspiration biopsy (FNAB) is widely used as an initial and direct diagnosis in cases of lymphadenopathy because it is a safe, easy and fast diagnostic technique [7][8][9][10]. The diagnosis of malignancy in colli lymphadenopathy by histopathological examination is based on cell morphology, cell composition, and changes in tissue structure. In the FNAB examination by only looking at the description of the cell composition and cell morphology, the diagnosis of malignancy can also be made on colli lymphadenopathy [11]. The characteristic advantages of FNAB are the low cost of the procedure, minimal risk of harm, and relatively painlessness patients, and fast turnaround times. Short time between FNAB performance and diagnostic availability enable rapid delivery of information to patients and requests
clinical decisions and initiation of appropriate therapy [12].

Although FNAB provides a diagnosis with a good degree of accuracy, some diagnoses may not provide definitive results [10][13]. This can occur due to insufficient amount of lesion material for the pathologist to make a diagnosis, which is usually described as an inadequate specimen[14]. Another reason why this can happen is when there are sufficient specimens but the cells obtained in the sample do not provide a specific diagnosis. A repeat FNAB is required if the patient has signs and symptoms that are alarming for malignancy or a persistent neck mass before proceeding to diagnosis by the open biopsy method [15].

An open biopsy is the definitive method of diagnosis to obtain results. This method is provided as a scenario when the FNAB fails to provide a diagnosis or more tissue is required by the pathologist [13][15]. Tissue biopsy is used as a method of final diagnosis or the gold standard for colli lymphadenopathy examination [16]. Diagnostic test is an observational study that is used to compare the results of an examination with a standard value that is close to the truth/gold standard. Validity measures used in the diagnostic test of this study are sensitivity, specificity, and accuracy. The diagnostic test efficacy of this study included positive and negative predictive values. Many studies have found that the diagnostic value of FNAB varies, this can be influenced by several factors, such as sample adequacy, superinfection, fibrosis, clinical and radiological information, pathologist experience in interpreting cytological specimens, and staining methods can affect diagnostic value [16]. So that on inspection FNAB colli lymphadenopathy is almost always followed by an open biopsy [17].

Based on this description, this study aimed to evaluate the diagnostic value of the FNAB examination in benign and malignant lymphadenopathy at RSPAL. dr. Ramelan, Surabaya, Indonesia. This research will assist hospitals in evaluating the performance of pathologists in order to improve patient care.

II. METHODHOLOGY

The type of research used is descriptive observation using medical records of patients with lymphadenopathy in the colli region who were examined by FNAB at RSPAL dr. Ramelan Surabaya. The results of the FNAB examination will be carried out a diagnostic test against the gold standard histopathological examination of paraffin blocks. The number of samples that meet the inclusion criteria in the study period totaled 66 samples.

This study uses observational retrospective data collection techniques by collecting data in the form of medical records (SIM-RS) of colli lymphadenopathy patients who performed FNAB examinations and continued histopathological examination of paraffin blocks at the Anatomical Pathology Laboratory Installation in the period January 2019 – March 2022.

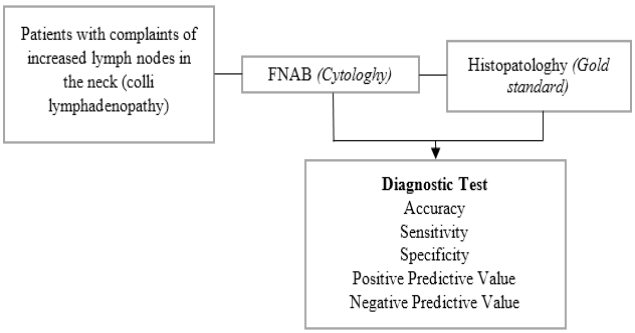


FIGURE 1. Research Flow Chart

According flow chart (FIGURE 1) explain that patients with enlarged KGB (colli lymphadenopathy) will undergo a diagnosis that is enforced by physical examination, history taking, and anatomical pathology biopsy examination [18]. Anatomical Pathology biopsy examination in patients with Colli Lymphadenopathy was carried out by 2 methods: FNAB and histopathology. To determine whether benign or malignant colli lymphadenopathy can be done by examining FNAB as a screening test, while paraffin block Histopathological Excision Biopsy is used as a definitive gold standard diagnosis [16].

Determination of Colli lymphadenopathy by FNAB examination and Histopathological Excision Biopsy has its own advantages and disadvantages. FNAB examination provides a quick diagnosis, does not require a long time, so that it can determine malignancy in colli lymphadenopathy immediately although not always specific, besides that

FNAB is an examination with a simple procedure and causes little trauma and low cost [19].

Histopathological examination can determine malignancy specifically, so that the diagnosis of FNAB almost always needs to be followed by a histopathological examination [16].

FNAB accuracy is affected by several criteria. Some of these criteria include: adequacy of materials, lower sampling techniques, errors in cytological interpretation, and limitations of the procedure [20]. During examination, samples must also be sent immediately to the Anatomical Pathology Unit so that the tissue components taken still reflect their initial conditions. Several interfering factors can also appear during cutting (knife artifact), freezing (freezing artifact and air bubbles), and paint impurity which may remain in the Hematoxylin-Eosin solution. While several factors can influence the results of histopathological examination of paraffin blocks as the gold standard, including during the cutting and tissue processing, block cutting, and painting. The quality of the aspirate affects the examination so that skills, knowledge, and experience are needed from cytologists in carrying out FNAB and Histopathology examinations [19].

The implementation of this research begins with observing the history of examination data at the anatomical pathology laboratory at (SIM-RS). The data collected was then processed using Microsoft Excel software to make it easier for researchers to determine data on colli lymphadenopathy patients who did FNAB and Histopathology examinations. The data obtained were classified according to the characteristics of the respondents, namely the distribution of the number of cases of lymphadenopathy colli to the type of tumor obtained and the classification of patients based on age.

The results of examination of FNAB and Histopathology data were then tabulated and classified using 2x2 crosstabulation statistics. After the cross tabulation test, the data were processed using a diagnostic test calculation based on the formula for accuracy, sensitivity, specificity, positive predictive value, negative predictive value, calculations with the following details (TABLE 1) [21].

TABLE 1
Cross tabulation 2x2

		Gold standard (Histopatologi Blok Parafin)		
FNAB		**Positive**	**Negative**	**Total**
	Positive	a	b	a + b
	Negative	c	d	c + d
Total		a + c	b + d	Total

where a is positive (malignant) FNAB examination results and positive (malignant) gold standard is TP (True Positive) b is positive (malignant) FNAB examination results and negative (benign) gold standard = FP (False Positive); c is negative (benignt) FNAB examination results and positive (malignant) gold standard which FN (False Negative), d is positive (malignant) FNAB examination results and negative (beningn) gold standard which FP (False Positive), a + c is TP + FN which the total number of people who are sick (determines the sensitivity value), b + d is FP + TN which the total number of people who are not sick (determines the specitifity value), a + b is TP + FP which the total number of people who test positive (determining a positive predictive value), c + d is FN + TN which the total number of people who test negative (determining a negative predictive value).

a. Sensitivity Diagnostic :
$$= \frac{TP}{TP+FN} \text{ x } 100\% = \frac{33}{33+7} \text{ x } 100\% = 82{,}5\%$$

b. Specificity Diagnostic :
$$= \frac{TN}{FP+TN} \text{ x } 100\% = \frac{25}{25+1} \text{ x } 100\% = 96{,}15\%$$

c. Negative Predictive Value :
$$= \frac{TP}{TP+FP} \text{ x } 100\% = \frac{33}{33+1} \text{ x } 100\% = 97{,}05\%$$

d. Positive Predictive Value :
$$= \frac{TN}{FN+TN} \text{ x } 100\% = \frac{25}{25+7} \text{ x } 100\% = 78{,}12\%$$

e. Diagnostic Accuracy :
$$= \frac{TP+TN}{Total} \text{ x } 100\% = \frac{33+25}{66} \text{ x } 100\% = 87{,}87\%$$

III. RESULTS

A. DISTRIBUTION OF THE NUMBER OF CASES OF LYMPHADENOPATHY COLLI THAT WENT THROUGH THE FNAB EXAMINATION IN THE PERIOD 2019 – MARCH 2022.

Based on the results of the examination data that has been done with tabulation tests and classification of colli lymphadenopathy patients who did FNAB and Histopathology examinations, there were 74 excluded samples. Then obtained a number of 66 samples taken from medical record data (SIM-RS) that meet the research inclusion criteria. Table 2 contains information on the distribution of patients with cases of lymphadenopathy in the period 2019 to 2022 (TABLE 2). Graph of Data Distribution of the number of cases of lymphadenopathy colli that went through the FNAB examination in the period

2019 – March 2022. Based on the sample data obtained during the study period, it showed that from a total of 66 cases of Colli Lymphadenopathy patients who had FNAB performed, 34 cases were found to be malignant with a percentage of 50.77% (FIGURE 2).

TABLE 2
Distribution of the number of cases of lymphadenopathy colli that went through the FNAB examination in the period 2019 – March 2022.

YEAR	TYPE OF TUMORS		NUMBER
	BENIGN	MALIGNANT	
2019	9	7	16
2020	10	10	20
2021	10	13	23
2022	3	4	7
NUMBER	32	34	66

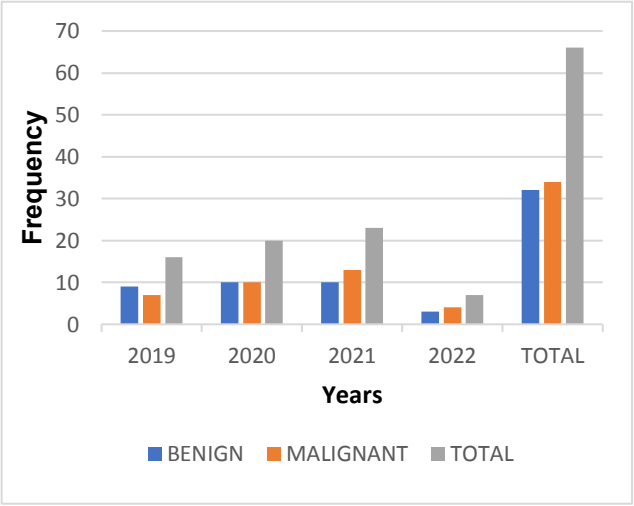


FIGURE 2. Data distribution of the number of cases of lymphadenopathy colli that went through the FNAB examination in the period 2019 – March 2022.

B. CLASSIFICATION OF COLLI LYMPHADENOPATHY PATIENTS BY AGE

TABLE 3
Classification of colli lymphadenopathy patients by age

Age	Benign	Malignant	Frequency	Percentage
01-10	0	2	2	3%
11-20	2	3	5	8%
21-30	1	10	11	17%
31-40	4	4	8	12%
41-50	8	8	16	24%
51-60	10	3	13	20%
61-70	3	2	5	8%
71-80	6	0	6	9%
Total	34	32	66	100%

The ages of colli lymphadenopathy patient's classified by TABLE 3 according to the patient's age along with the type of malignant and benign tumors. The total number of benign tumors was 34 and 32 the number of malignant tumors. Patients with colli lymphadenopathy cases when reviewed based on age range, show that the age range of 41-50 years is the age with the highest incidence of colli lymphadenopathy, with a total of 16 cases with a percentage of 24%. The most cases of malignant colli lymphadenopathy that underwent FNAB examination were found in the age range of 51-60 years with a total of 10 cases with a percentage of 20%. Whereas in benign cases, the most FNAB examinations were found in the age range of 21-30 years with a total of 10 cases with a percentage of 17% (FIGURE 3).

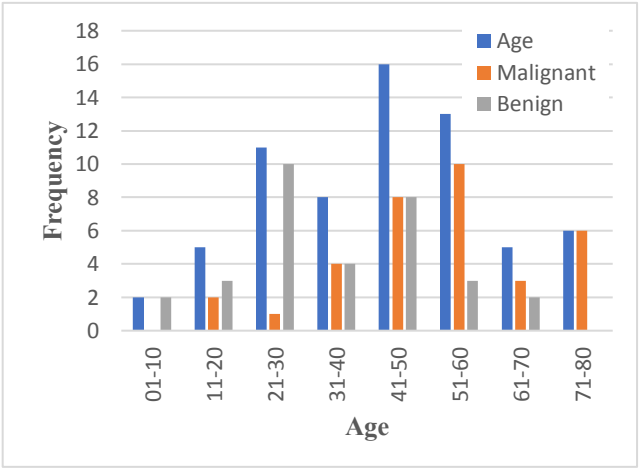


FIGURE 3. Classification of patients with Colli Lymphadenopathy by age

On physical examination, adults undergoing primary outpatient examination generally have visible lymph nodes. Although the incidence decreases with age [22]. Patients with lymphadenopathy aged 40 years or more have a malignancy risk of about 4%. Patients under the age of 40 years have a malignancy risk of 0.4%. Lymphadenopathy lasting less than 2 weeks or more than 1 year without progression in size has a very small probability that the etiology is malignancy[18]. Based on studies conducted, the age range of 41-50 has the highest number of colli lymphadenopathy cases that are often found (FIGURE 3). In the age range of 51-60 years has the highest number of patients with colli lymphadenopathy malignancy. According to TABLE 5, it explains that the data obtained were then tabulated and classified using the 2x2 crosstabulation statistic. Details of the tabulation details as in the table. The results of the FNAB examination which were confirmed by histopathological examination found malignancy in 34 cases, and 33 cases were found to be truly malignant/true positive. While 33 cases of benign FNAB

examination, only 25 cases were diagnosed as truly benign/true negative histopathologically.

TABLE 5
Patient Data on Colli Lymphadenopathy FNAB Examination and Paraffin Block Histopathology in the 2x2 Crosstabulation table.

		Gold standard (Histopatologi Blok Parafin)		
FNAB		**Positive**	**Negative**	**Total**
	Positive	33	1	34
	Negative	7	25	32
Total		40	26	66

IV. DISCUSSION

Based on research that has been done using secondary data through medical record data (SIM-RS) RSPAL dr. Ramelan Surabaya found colli lymphadenopathy patients who underwent examination in the period January 2019 – March 2022 as many as 74 specimens of colli lymphadenopathy. After processing the data and adjusting it based on the inclusion and exclusion criteria, the results obtained are 66 samples that meet the criteria as research samples.

Based on the data obtained, the highest number of cases of colli lymphadenopathy patients who were in FNAB and paraffin blok histopathology was in 2021, there was an increase in the number of colli lymphadenopathy patients who performed FNAB and Histopathology examinations at the Anatomical Pathology Laboratory, RSPAL dr. Ramelan Surabaya from 2019 to 2021.

Based on age analysis, colli lymphadenopathy was most common in the age range of 41-50 as many as 16 patients. Most cases of malignant tumors in the age range 51-60 as many as 10 patients. Most cases of benign tumors in the age range 21-30 as many as 10 patients. Meanwhile, in another study, the age range of malignant tumor cases was in the 41-60 age range. Based on a study conducted by patients with lymphadenopathy over the age of 40 years, the risk of malignancy was 4% when compared to those aged less than 40 years who had a risk of malignancy of only 0.4% [17]. Malignant cases often occur in elderly patients because they are associated with organ responses to infection [15].

After classification, from all 66 inclusion samples, the data was then cross tabulated and the results of the FNAB examination were 34 cases showing malignancy, after the sample was continued for histopathological confirmation examination only 33 cases showed truly malignant results. Meanwhile, of the 32 benign cases on FNAB examination, only 25 cases were completely benign after being confirmed by histopathological examination. One case was found to be false positive which was previously diagnosed as positive but after going through a histopathological confirmation examination the result was benign. Meanwhile, 7 false negative cases were found which were diagnosed as benign but after going through a histopathological confirmation examination the results showed malignancy. Diagnostic test is a tool used to compare the results of an examination with a standard value that is close to the truth/gold standard [23]. Validity measures used in the diagnostic test of this study are sensitivity, specificity, and accuracy. The efficacy of this research diagnostic test includes positive and negative predictive values.

The sensitivity value of this study shows how well the FNAB examination is able to identify patients with FNAB in sick patients. The sensitivity of the FNAB examination in this study was 82.5%. The sensitivity value is affected by the false negative and true positive results. The results of this calculation indicate that the ability of FNAB in diagnosing the presence of malignant disease/tumor in lymphadenopathy colli is good.

The specificity value indicates how well the ability of the FNAB examination in identifying patients with FNAB in patients who are not sick. the specificity value is influenced by false positive and true negative. Sample analysis showed the specificity value of the FNAB examination in this study was 96.15%. The specitifity value present the ability of FNAB examination in identifying patients with lymphadenopathy colli tumors is good.

Positive predictive value in this study obtained results of 97.05%. So if the previous results on the FNAB were diagnosed as malignant, it is very likely that the patient really had a malignant tumor. Based on the results of the analysis of this study, the high results obtained from positive predictive values explain that the FNAB examination can be used as a basis for diagnosis to determine further action in cases of patients with malignant lymphadenopathy colli.

Negative predictive value in this study obtained results of 78.12%. So if the previous results on the FNAB were diagnosed as benign, it is very likely that the patient really had a benign tumor. Based on the results of the analysis of this study, the results obtained were quite high from negative predictive values, but not as high as positive predictive values, this explains that there is still a possibility that patients with a diagnosis of benign tumors on FNAB examination after confirmed by histopathology the results show malignancy.

The results of this study, found 7 cases with false positives where the practitioner identified the specimen as malignancy on the FNAB examination so that the sensitivity value decreased. The results of this study also found 1 false positive case where the practitioner identified the specimen as a benign case on FNAB examination so that the specificity value decreased. This can be caused by errors in pre-analytical, analytical, and post-analytic factors.

FNAB is an important tool in evaluating cases of colli lymphadenopathy. although the use of FNAB is not widely

accepted by clinicians and surgical pathologists because of the lack of guidelines and a cytopathological categorization that directly relates to management, but the accuracy and progress in evaluating reliable ones is increasing [24]. Data analysis showed that the diagnostic accuracy value of the FNAB examination was 87.87%. This value indicates that the accuracy of the FNAB diagnostic test can be categorized as good in detecting lymphadenopathy colli when compared to histopathological examination as the gold standard of examination. The higher the accuracy value, the better the examination will be in diagnosing the disease [21]. However, in the FNAB examination, evaluation is still needed to reduce the number of false negatives and false positives. The accuracy results in this study are in line with the accuracy value of the research conducted by [16] which found the FNAB test accuracy value of 80.95%. A diagnostic examination will be better and more accurate if the accuracy value is close to 100% [25].

Many studies have found that the diagnostic value of FNAB varies [5][11][16][20]. Research conducted by [16] reported a sensitivity value of 85.88%, a specificity of 70.73%, and an accuracy value of 80.95%. Whereas in previous studies [26], they found that the sensitivity of the FNAB examination reached 84.5%, the specificity reached 99.3%, the positive predictive value reached 98.8%, and the negative predictive value reached 89. .9%, and an accuracy value of 93.1% from a total of 300 cases identified. The accuracy, sensitivity, specificity, positive predictive value, and negative predictive value of the FNAB examination technique have variations in previous studies. This is due to insufficient material collected during sampling or the sampling technique may be inferior [4].

Several factors causing errors in the diagnosis of lymphadenopathy colli that may occur in FNAB examination can be reviewed in the pre-analytic, analytical, and post-analytic processes. Sources of errors in the pre-analytic phase in FNAB and Histopathology examinations include the suitability of patient data and specimens that must be obtained. Errors in the analytical stage occur when the inspection process is in progress, the error can be in the form of an error systematically and random error [27]. Errors in the analytical stage can be caused by the use of fixation materials and sample handling procedures, the absence of aspirated tumor cells because the target is too small, as well as in the staining process which also greatly affects the reading of the interpretation of the results, cutting tissue using a microtome, insufficient smears [28][29]. When viewed quantitatively or qualitatively. errors in the post-analytic stage include errors in reading the interpretation of the results, such as tumor cells that may not be recognized by the practitioner for example in a mixture of non-malignant cells and malignant cells. Some errors are also supported by the experience of practitioners in interpreting cytological results. Most of the causes of errors in diagnosis are the result of improper practitioner interpretation. This incident, due to the FNAB examination only found cells, did not get a specific picture of a tumor. So histopathological examination is needed to confirm the diagnosis.

Despite the limited number in this study, our results suggest that FNAB is very useful in the case of suspicion colli lymphadenopathy [30]. FNAB is characterized by a low-cost technique, relatively painless pain level and requires a fast examination time in the case of malignant lymphadenopathy. This may not only help in the primary diagnosis of tumors, but FNAB remains a useful method for following up patients with known malignancies, and even guide therapy[31].

V. CONCLUSION

Based on the results of this study, the diagnostic test of FNAB examination with histopathology for the identification of colli lymphadenopathy patients at RSPAL. dr. Ramelan Surabaya is capable of detecting colli lymphadenopathy. The sensitivity value, the specifity value, the positive predictive value, the negative predictive value, the accuracy of the results , is 82.5%, 96,15%, 97,5%, 78,12%, 87,87%. In general, it can be stated that colli lymphadenopathy examination with FNAB can be a screening diagnostic tool in helping to establish the diagnosis of colli lymphadenopathy [17]. In future research, a likelihood ratio indicator can be added as a complementary data support to provide optimal results for the combination of screening tests.

REFERENCES

[1] H. Rusmini, R. Ariza, dan N. R. P. Sari, “Characteristics of Lymphadenitis in Hospitalised Patients Bandar Lampung-Indonesia,” *Malahayati Int. J. Nurs. Heal. Sci.*, vol. 2, no. 1, hal. 14–19, 2019, doi: 10.33024/minh.v2i1.1059.

[2] A. Deosthali, K. Donches, M. DelVecchio, dan S. Aronoff, “Etiologies of Pediatric Cervical Lymphadenopathy: A Systematic Review of 2687 Subjects,” *Glob. Pediatr. Heal.*, vol. 6, 2019, doi: 10.1177/2333794X19865440.

[3] D. Horas, “Kesesuaian Gambaran Ultrasonografi Gray Scale Dengan Hasil Biopsi Aspirasi Jarum Halus Dalam Membedakan Limfadenopati Leher Jinak Dan Ganas,” *Univ. Hasanudidin Pascasarj. Fak. Kedokt.*, vol. 1, 2017, [Daring]. Tersedia pada: http://digilib.unhas.ac.id/opac/detail-opac?id=36786.

[4] J. Zhou *et al.*, “Fine needle aspiration cytology for lymph nodes: A three-year study,” *Br. J. Biomed. Sci.*, vol. 73, no. 1, hal. 28–31, 2016, doi: 10.1080/09674845.2016.1144947.

[5] C. C. Göret *et al.*, “Diagnostic value of fine needle aspiration biopsy in non-thyroidal head and neck lesions: A retrospective study of 866 aspiration materials,” *Int. J. Clin. Exp. Pathol.*, vol. 8, no. 8, hal. 8709–8716, 2015.

[6] A. Rani, “Karakteristik Klinis dan Sitopatologi Fine Needle Aspiration Biopsy (FNAB) pada Massa Regio Colli di Laboratorium Patologi Anatomi Fakultas Kedokteran Universitas Andalas,” *J. Fak. Kedokt. Univ. Andalas 1*, hal. 6–9, 2019, [Daring]. Tersedia pada: http://scholar.unand.ac.id/61716/2/2. BAB 1 (Pendahuluan).pdf.

[7] B. Sushama, S. Samir, dan R. C. Sangita, “Diagnostic value of fine needle aspiration cytology in metastatic lymphadenopathy,” *Biomed.*, vol. 35, no. 1, hal. 55–59, 2018, doi: https://doi.org/10.3126/medphoenix.v3i1.20760.

[8] J. T Johnson, “Fine-Needle Aspiration of Neck Masses,” *Medscape*, hal. 1–12, 2018.

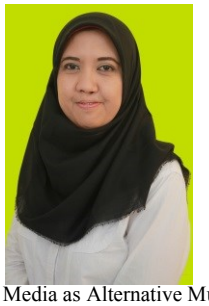
[9] H. A. Domanski, *Atlas of Fine Needle Aspiration Cytology*. 2014.
[10] M. D. Jeffers, J. Milton, R. Herriot, dan M. McKean, "Fine needle aspiration cytology in the investigation of non-Hodgkin's lymphoma," *J. Clin. Pathol.*, vol. 51, no. 3, hal. 189–196, 1998, doi: 10.1136/jcp.51.3.189.
[11] K. Alam, V. Maheshwari, N. Haider, F. Siddiqui, A. Jain, dan A. Khan, "Fine needle aspiration cytology (FNAC), a handy tool for metastatic lymphadenopathy," *Internet J. Pathol.*, vol. 10, no. 2, hal. 1–7, 2010, doi: 10.5580/1df3.
[12] B. J. Hall, R. L. Schmidt, R. R. Sharma, dan L. J. Layfield, "Fine-needle aspiration cytology for the diagnosis of metastatic melanoma: Systematic review and meta-analysis," *Am. J. Clin. Pathol.*, vol. 140, no. 5, hal. 635–642, 2013, doi: 10.1309/AJCPWSDDHLLW40WI.
[13] M. Ingolfsdottir, V. Balle, dan C. H. ols. Hahn, "Evaluation of cervical lymphadenopathy in children: advantages and drawbacks of diagnostic methods," *Dan. Med. J.*, vol. 60, no. 8, hal. A4667, 2013.
[14] D. Daskalopoulou, A. D. Rapidis, N. Maounis, dan S. Markidou, "Fine-needle aspiration cytology in tumors and tumor-like conditions of the oral and maxillofacial region: Diagnostic reliability and limitations," *Cancer*, vol. 81, no. 4, hal. 238–252, 1997, doi: 10.1002/(SICI)1097-0142(19970825)81:4<238::AID-CNCR6>3.0.CO;2-L.
[15] K. Chorath dan K. Rajasekaran, "Evaluation and Management of a Neck Mass," *Med. Clin. North Am.*, vol. 105, no. 5, hal. 827–837, 2021, doi: 10.1016/j.mcna.2021.05.005.
[16] E. K. Dwianingsih *et al.*, "Accuracy of fine needle aspiration biopsy to diagnose lymphadenopathy in Dr.Sardjito General Hospital, Yogyakarta, Indonesia," *J. thee Med. Sci. (Berkala Ilmu Kedokteran)*, vol. 52, no. 01, hal. 48–59, 2020, doi: 10.19106/jmedsci005201202006.
[17] Delyuzar, Z. Amir, dan D. Suryadi, "Diagnostic accuracy of lymphoma established by fine-needle aspiration cytological biopsy," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 125, no. 1, hal. 11–14, 2018, doi: 10.1088/1755-1315/125/1/012136.
[18] A. Oehadian, "Pendekatan Diagnosis Limfadenopati," *Cdk-209*, vol. 40, no. 10, hal. 727–732, 2013.
[19] J. R. Miliauskas, *Lymph Nodes*. 2012.
[20] Wiganda, D. Achmad, dan M. Abdurahman, "Akurasi Pemeriksaan Biopsi Aspirasi Jarum Halus (BAJAH) dalam Diagnosis Keganasan Kelenjar Getah Bening Leher," *J. llmu Bedah Indones.*, vol. 35, no. 2, hal. 18–22, 2007, doi: 10.46800/jibiikabi.v35i2.128.
[21] I. A. E. Putra, I. Sutarga, M. Kardiwinata, N. Suariyani, N. Septarini, dan I. Subrata, "Modul Penelitian Uji Diagnostik Dan Skrining," *Progr. Stud. Kesehat. Masy. Fak. Kedokt. Univ. Udayana*, hal. 45, 2016, [Daring]. Tersedia pada: https://simdos.unud.ac.id/uploads/file_pendidikan_1_dir/d204d4a5ad0870a0965416e671a38791.pdf.
[22] A. Bazemore dan D. Smucker, "Lymphadenopathy and Malignancy," *Am. Fam. Physician*, vol. 66, no. 11, hal. 2103–2110, 2002, [Daring]. Tersedia pada: www.aafp.org/afp.
[23] A. R. Tumbelaka, "Telaah Kritis Makalah Uji Diagnostik," *Sari Pediatr.*, vol. 4, no. 2, hal. 98, 2016, doi: 10.14238/sp4.2.2002.98-102.
[24] A. P. Bueno *et al.*, "Accuracy of fine-needle aspiration of lymph nodes: A cancer center's experience," *Cytopathology*, vol. 33, no. 1, hal. 114–118, 2022, doi: 10.1111/cyt.13057.
[25] S. Sastroasmoro dan I. Sofyan, *Dasar-dasar Metodologi Penelitian Klinis*, 4 ed., vol. 4. Sagung Seto, 2011.
[26] J. Attard, J. Galea, dan A. Betts, "The efficacy of lymph node fine needle aspiration cytology," *Malta Med. J.*, vol. 27, no. 3, hal. 16–21, 2015.
[27] M. Tuntun, W. Sriwulan, D. Setiawan, dan A. Nuryati, *Kendali Mutu*. 2018.
[28] M. Underbink, "Evaluation and Management of the patient with a neck mass December 2001," no. December, hal. 1–9, 2001.
[29] RSUD Prof. Dr. Margono Soekarjo Purwokerto, "Pedoman Pelayanan Instalasi Patologi Anatomi," hal. 22, 2018.
[30] Y. Houcine *et al.*, "Evaluation of fine needle aspiration cytology in the diagnosis of cervical lymph node lymphomas," *J. Cranio-Maxillo-Facial Surg.*, 2018, doi: 10.1016/j.jcms.2018.04.024.
[31] N. A. Al-Alwan, A. S. Al-Hashimi, M. M. Salman, dan E. A. Al-Attar, "Fine needle aspiration cytology versus histopathology in diagnosing lymph node lesions," *Eastern Mediterranean Health Journal*, vol. 2, no. 2. hal. 320–325, 1996, doi: 10.26719/1996.2.2.320.

DEVAN ANDHIKA born in Surabaya, 2001. He completed pharmacy vocational high school in 2018. In 2018 he start medical Laboratory Technology college education and will finish in 2022.

He did an internship in 2017 as a pharmacy assistant at RSUD dr. Soewandi Surabaya. He did an internship in 2022 as a laboratory at RSPAL dr. Ramelan Surabaya.

ANIK HANDAYATI born in Magetan, 1964. She obtained his S.Si degree in Chemistry from Airlangga University, Surabaya in 1989. In 2003 she received his M.Kes degree in laboratory medicine from Airlangga University and obtained his doctorate in 2003 2018 in the field of Medical Science from Airlangga University.Since 2000 – now. She working as a lecturer at the Health Polytechnic of the Ministry of Health Surabaya, majoring in medical laboratory technology. Became an analyst at Dr. Hospital. Soetomo Surabaya in 1982 – 1998. In the last 5 years, he has published 8 research journals and 3 books, two of which are Basic Laboratory Management and Environmental Health and Clinical Chemistry: Medical Laboratory Technology Expertise Program, as well as one of eight published research journals is Correlation Between Implementation Intensity Of Internal Quality Control And The Outcome Of External Quality Control In The Parameter Of Complete Blood Count At Public Health Center Laboratories, Gianyar Regency ISSN: 2580-4936

Dr. Anik Handayati, dra., M.Kes is one of the administrators at DPC Patelki Surabaya since 2016 until now.



EVY DIAH WOELANSARI. was born in Surabaya, 1975. She obtained the title of Amd. Case in the field of Medical Analyst from Airlangga University. Obtained his S.Si degree in Biology from PGRI Adi Buana University Surabaya and obtained his M.Kes degree in Immunology from Airlangga University.

Evy Diah Woelansari, S.Si M.Kes in the past 5 years, she has published 5 research journals, including; Characteristics of Aspergillus sp. And Penicillium sp. In Peanut Sucrosa Agar (PSA) Media as Alternative Mushroom Media Candidates (2020), Peanut Sucrosa Agar (PSA) As Candida albicans Modification Media in Urine of Diabetes Mellitus Patients (2019), The Effectiveness of Black Cumin Extract (Nigella sativa L) Against the Number of Eosinophil Cells in Allergic Mice Blood and Intestinal Tissue (2018)