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# Assessing the Inter-observer Agreement of Electrocardiography Interpretation in the Elderly Surgical Patients: A Cross-Sectional Study

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## Abstract

**Background :** Electrocardiography (ECG) is an essential objective diagnosis tool, specifically for the elderly who are about to undergo surgery. From the examination results, it is possible to determine the presence of a heart condition that could impair the surgical outcome. Furthermore, the examination is slightly influenced by the subjectivity of observers. The purpose of this study was to evaluate the inter-observer agreement on the reader of a 12-lead ECG on elderly patients subjected to elective surgery.
**Methods :** A consequential ECG examination was conducted on elderly patients who underwent elective surgery at Dr. Kariadi Hospital Semarang between July and November 2021. Two junior internist observers were independently involved in reading the ECG results in different places. The inter-observer reliability analysis used kappa statistics to determine consistency between observers.
**Results :** Analysis was carried out on 193 patients aged 60–87 years old, with a prevalence of abnormal ECG was 33.7%. Kappa Conformity Value was 0.864 (95 % CI: 0.790–0.938, p<0.001).
**Conclusion :** The value of agreement between junior internists in ECG interpretation among elderly surgical patients is good (kappa value >0.8). Even though the observers are junior internist, the result of the interpretation with a high kappa is considered to have reliable validity.

**Keywords :** Electrocardiography, elective surgery procedure, elderly

## INTRODUCTION

The increase in life expectancy leads to a rise in the elderly for surgical procedures, and the cardiovascular system is associated with various structural and functional changes in the heart and blood vessels. Furthermore, the myocardium has increased stiffness due to fibrosis and hypertrophy, and this magnification structure can be seen from the Electrocardiography (ECG) surface.[1,2] ECG is an essential diagnostic tool in medicine, and as a clinician, it is vital to know the general and dangerous patterns.[3]

Preoperative ECG is a routine examination to identify patients' cardiovascular and arrhythmia abnormalities. ECG examination is sometimes influenced by subjectivity in the analysis. Therefore, a study has been conducted to determine the inter-observer agreement on ECG examination in elderly patients, evaluated individually by two junior internist doctors at Dr. Kariadi Hospital Semarang. We choose junior internis to participate in research because they should develop a better understanding of the principle of evidence-based medicine.

## MATERIALS AND METHODS

The cross-sectional study included patients aged 60 years or older who underwent elective surgery with general anesthesia at Dr. Kariadi Hospital from June to December 2021. Patients who had undergone outpatient surgery or emergency surgery were excluded. Selection of samples by concurrent sampling obtained 193 subjects.

The ECG machine used to examine subjects was MAC 400, produced by GE Medical Systems Information Technologies China, with the SCT tool series number 11413002 WA. ECG paper printed did not contain an automatic interpretation of the machine. A certified nurse did the ECG recording of 12 leads and independently read by two junior general internists at different places. The ECG reading analysis technique was based on knowledge gained during specialist education. The junior internists were doctors with up to five years of working and experience to become internists.

Furthermore, the data were coded, tabulated, and entered into the computer. The data obtained were checked for completeness and correctness. Statistical and Descriptive analyses were conducted using SPSS and univariate analysis, respectively. Variables that scale to categories were expressed in frequency and percentage distributions. Following the normal distribution, data with a numerical scale were expressed as mean and standard deviation or as median and range when distributed abnormally. The suitability between observations was analyzed using the Kappa test, with its p-value and confidence interval. Ethical clearance was obtained from the health study ethics committee of RSUP Dr. Kariadi with number 842/EC/KEPK-RSDK/2021.

## RESULTS

The characteristics of the subjects can be seen in Table 1. Age variables are divided into three groups based on WHO criteria.

TABLE 1
**Subjects' Characteristics**

| Variable | | n | % | Median (Minimum–Maximum) |
|---|---|---|---|---|
| Age (years) | 60–70 years old | 155 | 80.3 | 66 (60–87) |
| | 71–80 years old | 32 | 16.6 | |
| | ≥ 81 years old | 6 | 3.1 | |
| Gender | Male | 95 | 49.2 | |
| | Female | 98 | 50.8 | |
| Marital Status | Married | 161 | 8.4 | |
| | Not married | 32 | 16.6 | |
| Education Status | Finished college/university | 15 | 7.8 | |
| | Finished Senior High School | 62 | 32.1 | |
| | Finished Junior High School | 18 | 9.3 | |
| | Finished Elementary School | 77 | 39.9 | |
| | Unfinished Elementary School | 3 | 1.6 | |
| | Non-educated | 18 | 9.3 | |

*TABLE 1. Continued.*

| Variable | | n | % | Median (Minimum–Maximum) |
|---|---|---|---|---|
| Comorbidities | Hypertension | 54 | 28 | |
| | Liver Disease | 12 | 6.2 | |
| | Hemiplegia | 3 | 1.6 | |
| | Chronic Kidney Disease | 4 | 2.1 | |
| | Peptic Ulcer | 2 | 1 | |
| | COPD | 2 | 1 | |
| | Dementia | 1 | 5 | |
| | Peripheral Vascular Disease | 1 | 5 | |
| | CVD | 7 | 3.6 | |
| | Infark Miocard | 8 | 4.1 | |
| | Congestive Heart Failure | 14 | 7.3 | |
| | Diabetes Mellitus | 41 | 21.2 | |
| | Solid tumor | 96 | 49.7 | |
| Total | | 193 | 100.0 | |

Note: COPD (Chronic Obstructive Pulmonary Disease); CVD (Cerebro Vascular Disease)

TABLE 2
**Agreement value between Observer A and Observer B**

| Variable | | Observer B | | Total |
|---|---|---|---|---|
| | | Positive | Negative | |
| Observer A | Positive | 119 (61.7%) | 9 (4.7%) | 128 (66.3 %) |
| | Negative | 3 (1.6 %) | 62 (32.1%) | 65 (33.7%) |
| | Total | 122 (63.2 %) | 71 (36.8%) | 193 (100 %) |

*Kappa 0,864 (CI 95% 0.790–0.938); p-value < 0.001

The inter-observe agreement value can be seen in Table 2. The observers gave the same result (concordance) as much as 93.8 %, and The observers gave a different result (discordant) of 6.2 %), with a kappa value of 0.864, which is categorized as a good agreement.

In Table 3, the ECG readings obtained are listed, and the differences between observers can be seen in the readings of normal sinus rhythm, RBBB (Right Bundle Brand Block), OMI (Old Myocardial Infarction), LAD (Left Axis Deviation), LAE (Left Atrial Enlargement), and Ischemic anteroseptal.

The results of the ECG abnormality reading between observers A and B can be seen in Figure 1.

## DISCUSSION

In this study, the inter-observe agreement had a kappa value of 0.894 (95% CI: 0.790 – 0.938). It is better than Schneiter and colleagues' study, which examined inter-observe suitability in athletes between cardiological and electrophysiological residents with a kappa value of 0.539 (CI 95 % 0.419–0.685). It was also compared to a study conducted between senior internship medical students and cardiological residents with a kappa value of 0.720 (CI 95%: 0.681-0.821). This is likely due to the different levels of education of observers in Schneiter's study.[4] In this research, the quality and homogeneity test of two general internists read the ECG is good with the Levene test 0.556, which means it is homogeneous. This research is almost the same as that conducted by Terho, who obtained a Kappa value of 0.81 to analyze all leads. In Terho's study, the population was young adults, and ECG was read by two people independently without mentioning their education.[5]

TABLE 3
**Types of ECG Readings**

| ECG reading | Observer A n (%) | Observer B n (%) |
|---|---|---|
| NSR | 109 (56.5) | 107 (55.4) |
| RBBB | 9 (4.7) | 8 (4.1) |
| AV Block 1st degree | 3 (1.6) | 3 (1.6) |
| OMI | 6 (3.1) | 7 (3.6) |
| Sinus Tachycardia | 7 (3.6) | 7 (3.6) |
| Sinus Aritmia | 1 (0.5) | 1 (0.5) |
| VES | 1 (0.5) | 1 (0.5) |
| Non-specific St | 7 (3.6) | 7 (3.6) |
| LAD | 14 (7.3) | 13 (6.7) |
| Ischaemic anterolateral | 6 (3.1) | 6 (3.1) |
| Ischaemic anterior | 2 (1.0) | 2 (1.0) |
| LAE | 10 (5.2) | 11 (5.7) |
| IVCD | 1 (0.5) | 1 (0.5) |
| Atrial fibrillation | 2 (10) | 2 (1.0) |
| AV Blok ck 2nd degree | 1 (0.5) | 1 (0.5) |
| Bradicardia sinus | 4 (2.1) | 4 (2.1) |
| Ischaemic whole-wall | 1 (0.5) | 1 (0.5) |
| LVH | 1 (0.5) | 1 (0.5) |
| Ischaemic anteroseptal | 8 (4.1) | 10 (5.2) |
| Total | 193 (100) | 193 (100) |

Abbreviation: NSR (Normo sinus rhythm); RBBB (Right Bundle Brand Block); OMI (Old Miocard Infark); VES (Ventricle extra systole); LAD (Left Axis Deviation); LAE (Left Atrial Enlargement); IVCD (Intra Ventricular Conducting Defect); AV (Atrio Ventricular); LVH (Left Ventricular Hypertrophy).

From the results, most study subjects were in the age group of 60–70 years. This is slightly different from the study conducted by Yeh *et al*., with the age of the subjects between 65–104 years. The difference is related to the age of older adults and the life expectancy of the Indonesian population based on the Central Statistics Agency of around 70.9 years.[6,7] The gender of the subjects was more women because their life expectancy was slightly longer than males. The female had lower mortality than males because of a low prevalence of most specific systemic variables.[8] Based on marital status, 100% of subjects have been married. This is because the culture in Indonesia that views marriage as mandatory shows a person's level of maturity.[9] The most works recorded are housewives since 50.8% of the subjects belonged to this category. This study focused on the Java tribe because it was conducted on Java Island. Hypertension was found in 28 % of the subjects, possibly due to arterial stiffness in the elderly.[10]

The results of the ECG reading found abnormalities in 43.5% and 44.6% of the elderly subjected to surgery on observers A and B. The two main hypotheses that explain the existence of age-related ECG changes are in the topography of the heart concerning the thorax and diaphragm, as well as the presence of degenerative structural modifications of the conduction system and heart muscle.[1]

Based on the ECG abnormalities, most are LAD, LAE, RBBB, and Ischaemic anteroseptal. In this study, most LAD was likely due to the comorbidity of hypertension based on the study of Romhilt and Estes to diagnose the presence of LVH, changes in ST segments, LAD, and abnormalities of the left atrial.[11]

In addition, RBBB was found with 4.7% in Observer A and 4.1% in Observer B, while LBBB was not found. This funding is in line with a study conducted by

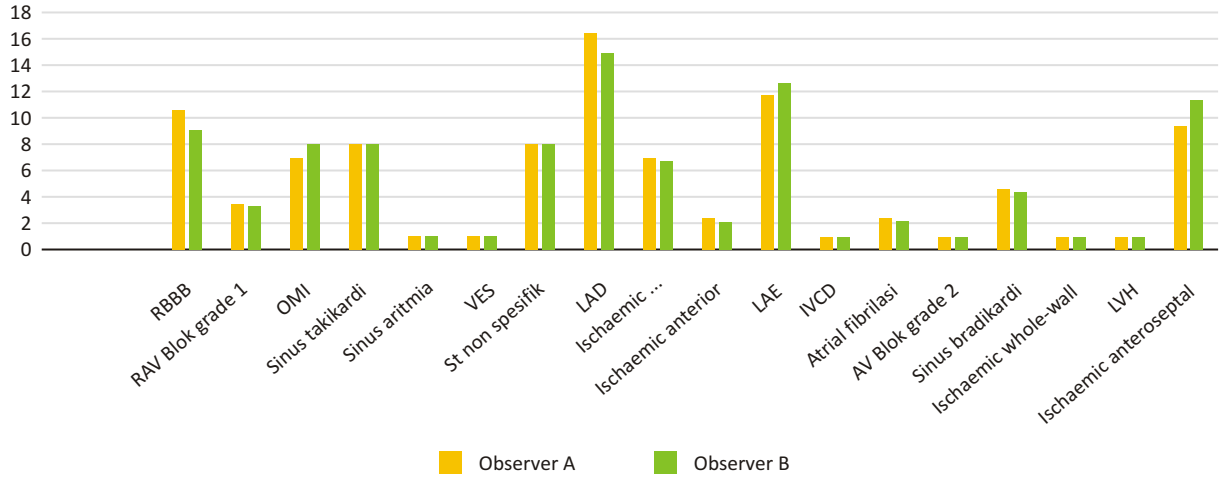


**Figure 1.** ECG Abnormality Results obtained between Observers A and B
Abbreviation: RBBB (Right Bundle Branch Block), AV (Atrio Ventricular), OMI (Old Miokard Infark), VES (Ventrikel Extra Systolic), LAD (Left Axis Deviation), LAE (Left Atrial Enlargement), IVCD (Intra Ventricular Septal Defect), LVH (Left Ventricular Hypertrophy).

Mihalick and Fisch, where RBBB is more common than LBBB in elderly patients. Generally, Bundle Branch Block is caused by changes in fibro calcification of the conduction system compared to ischemic heart disease.[12] The Baltimore Longitudinal Study of Aging found 3.4% of which is a complete RBBB.[13] In the study of Yeh and friends, 5.05% found complete RBBB.[6]

Observe A found anteroseptal ischemic with 4.1%, and Observe B with 5.2%. The most common cause of ischemic in the elderly is atherosclerosis. Therefore, the elderly with this disease tend to have a prevalence of cardiovascular risk, specifically hypertension, diabetes mellitus, and dyslipidemia.[14] Ishaemic myocardium is a public health problem, and the prevalence increased in the sixth decade. Furthermore, it has been the major cause of death in the elderly, greatly influencing hospitalization and invasive procedures.[15] LVH was obtained in 0.5% of the subjects and has been appointed as a predictor for systolic and diastolic heart failure.[16] Based on Table 3, we can assume that even though kappa is good, ECG readers have the same level of education, different ECG interpretation inter-observer are still found, such as NSR, RBBB, OMI, LAD, LAE, and anteroseptal ischaemic between observe A dan B. Therefore, if any of the above is found in clinical practice, the examining doctor cannot be 100 % sure of the abnormality; it is better if another doctor reads it to make a more objective decision. As regards limitations, this is a study from one central hospital, and it has to be confirmed in a multicentre study on a large scale.

## CONCLUSION

This study found that the ECG readings in the elderly to be interpreted by internists had almost similar results. The value of agreement between junior internists in ECG interpretation among elderly surgical patients is good (kappa value >0.8).

### Conflict of Interest

All authors have nothing to disclose.

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