ORIGINAL ARTICLE

Comparison of placement time duration between precordial lead of ECG Safone and Standard ECG

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ABSTRACT

Introduction*: The misplacement of precordial electrodes in the electrocardiography (ECG) recording sometimes occurs in the field. Therefore, it needs a simple and easy use of precordial electrodes of ECG that can determine the position of the precordial electrodes fast and accurately.* ***Objectives****: This study aimed to compare placement time duration between the precordial lead of ECG SafOne and the precordial lead of standard ECG.* ***Methods****: This study employed an experimental study design with a post-test-only equivalent group method. There were 30 subjects involved in this study who were selected using purposive technic sampling. All-time durations of precordial lead placement gained from subjects using both ECG SafOne and standard ECG were identified and measured. Data were analyzed using Wilcoxon signed-rank test to compare the precordial lead of ECG SafOne and standard ECG.* ***Results****: The results showed that most subjects involved were elderly (56-65 years old) (46,7 %) and most were male (60%). The result of this study showed that the average placement time duration for ECG SafOne precordial lead is 52,90 seconds, while standard ECG precordial lead is 152,9 seconds. Based on bivariate analysis, there is a remarkable difference in the placement time duration of precordial lead between ECG SafOne and standard ECG with a p-value of 0,000 < α (0,05).* ***Conclusions:*** *The time duration of precordial lead placement of ECG SafOne is significantly faster than standard ECG. To some extent, the result of this study has a beneficial implication for health care professionals in terms of providing professional services by reducing the time to record electrocardiography.*

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1. Introduction

Cardiovascular diseases (CVD) are the most common cause of death worldwide and contribute to decreased quality of life (Mensah, Roth & Fuster, 2019). According to World Health Organization (WHO), 31% of 56.5 million deaths worldwide are caused by cardiovascular diseases. In 2017, CVDs caused an estimated 17.8 million deaths worldwide (Mensah et al., 2019). It is predicted that by 2030, the deaths from CVD will have increased to more than 23 million (Kemenkes RI, 2018).

Data from Riset Kesehatan Dasar (Riskesdas) in 2018 showed the prevalence of cardiovascular disease based on doctor's diagnosis in Indonesia was 1.5%, or 1,017,290 diagnosed cardiovascular disease. In Riau, the prevalence of cardiovascular disease was 26,085 people (Riskesdas, 2018). The data above shows that the mortality and morbidity of cardiovascular disease are pretty high and will increase. Heart attacks cause most deaths from cardiovascular disease without any previous symptoms (Santosa & Baharuddin, 2020).

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Misperceptions about the cardiovascular disease are thought to affect alertness to cardiovascular disease (Rosjidi, 2020).

Rapid detection of signs and symptoms of CVD is vital for implementing effective evidence-based intervention and mortality prevention. Any delays in treating patients with signs and symptoms of CVD, especially those with symptoms of myocardial infarction (MI), affect mortality and increase the risk of death (Cho et al., 2020). Electrocardiography (ECG) is a diagnostic test commonly used for the early diagnosis of cardiac problems (Kania et al., 2014). ECG recording represents the electrical activity of the heart muscle as detected by electrodes placed at different places or locations on the body's surface (Kania et al., 2014). ECG is of noninvasive diagnostic examination that is very useful to help diagnose disease, especially heart disease (Nazmah, 2012).

The ECG commonly used in hospitals is a standard ECG whose working principle uses several leading points from the body. The standard ECG widely used to date is fixed on the body, where the electrodes stick directly to the skin (Emilia & Arifin, 2016). A standard ECG uses a standard 12 lead to record the heart's electrical activity (Brosche, 2011). This standard ECG uses ten electrodes, four limbs, and 6 precordial leads (Brosche, 2011).

Accurate placement of the precordial lead in compliance with the specified lead points on the body surface is essential to obtain an accurate interpretation of the ECG recordings because the inaccurate placement of the lead will alter the diagnostic results (Kania et al., 2014). However, accurate lead placement for some healthcare providers sometimes takes time, and they must precisely identify the places or location of the precordial lead. In an emergency, chest pain or other signs of ischemia require an assessment with ECG as soon as the patient arrives at the emergency room (PERKI, 2015). However, if the lead's placement is improper, it can trigger inaccurate ECG recording, which is central to wrong interpretation.

Displacement of precordial lead on the patient's chest sometimes occurs during ECG recording. A study by Gregory et al. (2019) on the accuracy of ECG electrode placements reported a significant rate of inaccuracy with only 3 out of 52 participants (5.8%) able to place chest electrodes accurately. Another study by Medani, Hensey, Caples, and Owens (2018) found that only 10 out of 100 (10%) participants could accurately identify and place electrodes on the chest. This result indicates that some healthcare workers are facing difficulties in terms of the accuracy of precordial lead placement in ECG tests. Therefore, to solve this issue, the innovation of a precordial lead ECG device that can precisely determine the position of the precordial lead is required. It will simplify and expedite healthcare workers' work to conduct ECG tests and provide patients with prompt and appropriate treatment. This device is named ECG SafOne. The ECG SafOne precordial lead is a portable precordial lead formulation used to record ECG. It can help health workers do ECG examinations by locating V1 precordial lead and precisely placing all precordial lead locations on the patient's chest. Therefore, this study investigates the placement time duration of precordial lead of ECG SafOne and standard ECG in recording electrocardiography.

2. Methods

This study used a quasi-experimental research design with a post-test-only equivalent group conducted in May – July 2021. The samples of this study were 30 outpatients at the cardiovascular polyclinic at one of the public hospitals in Pekanbaru who had been diagnosed with cardiovascular disease, which were selected using purposive sampling. All respondents received both ECG test that is ECG SafOne precordial lead and standard ECG precordial lead. The time required during the precordial lead placement was measured and collected with a digital stopwatch. Time measurement is commenced once the V1 position is located and ends when V6 is appropriately placed. Data were analyzed using both univariate and bivariate analysis.

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Wilcoxon signed-rank test was employed to see the comparison placement time duration between ECG SafOne and standard ECG investigated in this study.

This study has been granted ethics approval from the Nursing and Health Research Ethics Committee of the Faculty of Nursing, Universitas Riau, with the certificate number 137/UN.19.5.1.8/KEPK.FKp/2021.

3. Results and Discussion

Table 1 shows that characteristics of the respondents are in the late elderly age group (56-65 years) 46,7%, male (60%), predominantly married (80%), education level is Senior High School (26,7%), and 19 respondents are unemployment (63.3%). Regarding disease diagnosis, most respondents were diagnosed with CAD (Coronary Artery Disease) (23,3%). While BMI (Body Mass Index), the majority of respondents are obese with a range of 25-29.9kg/m^2 (46.7%).

Table 1 Frequency distribution of respondent's characteristics of age, gender, marital status, education, occupation, disease diagnosis, and BMI

No	Respondent's Characteristics	n = 30	
		f	**%**
1	**Age:**		
	a. Early adulthood (26-35 years old)	1	3,3
	b. Late adulthood (36-45 years old)	1	3,3
	c. Early elderly (46-55 years old)	6	20,0
	d. Late elderly (56-65 years old)	14	46,7
	e. Elderly (>65 years old)	8	26,7
2	**Gender:**		
	a. Male	18	60,0
	b. Female	12	40,0
3	**Marital Status:**		
	a. Married	24	80,0
	b. Widowed	6	20,0
4	**Education level:**		
	a. Primary School	4	13,3
	b. Junior High School	4	13,3
	c. Senior High School	8	26,7
	d. Diploma	4	13,3
	e. Bachelor	7	23,3
	f. Master	3	10,0
5	**Occupation:**		
	a. Employment	11	36,7
	b. Unemployment	19	63,3
6	**Disease Diagnosis**		
	a. CAD *(Coronary Artery Disease)*	7	23,3
	b. HHD (*Hypertensive Heart Disease*)	6	20,0
	c. CHF (*Congestive Heart Failure*)	6	20,0
	d. Bell's palsy	1	3,3
	e. Mitral Stenosis	1	3,3
	f. Bradycardia	1	3,3
	g. UAP (*Unstable Angina Pectoris*)	2	6,7
	h. AP (*Angina Pectoris*)	2	6,7
	i. AHD (*Artery Heart Disease*	2	6,7
	j. MCI (*Myocardial Infarction*)	2	6,7
7	**BMI (Body Mass Index):**		
	a. Normal (18,5-22,9 kg/m^2)	11	36,7
	b. Overweight (23-24,9 kg/m^2)	4	13,3

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c.	Obese (25-29,9 kg/m²)	14	46,7
d.	Obese II (>30 kg/m²)	1	3,3

Table 2 shows that the average time for placing the standard ECG precordial lead is 152.90 seconds, with a minimum value of 64 seconds and the highest value of 272 seconds. The average time to locate ECG SafOne precordial lead is 52,90 seconds, with a 20-second minimum value and the highest value of 237 seconds.

Table 2 An overview of the placement duration for ECG SafOne precordial lead and standard ECG precordial lead (in seconds)

Variable	N	Mean	Min	Max
Length of time for locating Standard ECG precordial lead (seconds)	30	152,90	64	272
Length of time for locating precordial lead ECG SafOne (seconds)	30	52,90	20	237

Table 3 shows the differences in the placement time duration between the standard ECG precordial lead group and ECG SafOne precordial lead using the Wilcoxon test showed a significant value of p 0.000 < (0.05).

Table 3 Comparison of the placement duration of the SafOne ECG precordial lead and the standard ECG

	N	Mean±SD	*P value*
Precordial lead Standard ECG group	30	152,90±61,71	0,000
Precordial lead ECG SafOne group	30	52,90±41,31	

The results of the comparative analysis of the length of time for placing the standard ECG precordial lead and the ECG SafOne precordial lead were done using the Wilcoxon statistical test (p-value 0,000 < α (0,05)) obtained that there was a significant difference between the length of time for placing standard ECG precordial lead and the ECG SafOne.

This study compared the length of time of placing the standard ECG precordial lead and the ECG SafOne precordial lead. Time is counted starting from identifying and assigning the V1-V6. We found that the placement time duration of ECG SafOne precordial lead is faster than standard ECG precordial lead. The duration time of ECG SafOne precordial lead is faster than standard ECG because the ECG SafOne is designed to practically and accurately identifies precordial lead. The ECG Safone precordial lead allows health care professionals to rapidly engage precordial lead by identifying the V1 and V2 positions and automatically finding V3-V6. A previous study conducted by Bell et al. (2001) investigated the precordial ECG Belt regarding its accuracy and reproducibility. However, they did not measure how ECG Belt works efficiently concerning time compared with standard precordial. Furthermore, the design, aim, and material used for these two tools differ; therefore, it will reflect on the result of the findings study.

From this study, we found the difference in the length of placement time of the two precordial leads was caused by several things, such as the placement procedure of the two devices and the characteristics of the respondents, including gender and BMI. First, the placement procedure of precordial lead between the two devices is different. The placement time of precordial lead on a standard ECG is performed by identifying the lead points one by one of V1-V6. Meanwhile, using the ECG SafOne, precordial lead V1-V6 is identified at one time by indicating V1 and V2, and then V3-V6 points are automatically assigned. Drew (2006) stated that the position of the V1 precordial lead is significant because V1 is the first precordial lead to be placed, and the other five precordial leads are placed concerning the V1 electrode placement. Therefore, the

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placement of V1 precordial lead in the correct position will simultaneously determine the position of V2 to V6, and conversely, if the placement of the V1 position is not precise, it will affect the V2-V6 placement, which will result in inaccurate ECG recordings as well (Drew, 2006).

Second, the characteristics of the respondents, such as sex and body mass index can contribute to the length of time for locating the precordial electrocardiogram lead. This study revealed that the longest time for placing the precordial lead of the two devices was found in female respondents with obese BMI. Different sizes and shapes of breasts can influence the differences in women, so the placement of precordial lead requires a longer time, especially when identifying the lead points of the chest. According to Drew (2006), a significant factor that can complicate the placement of the precordial lead in women if it has large and sagging breasts, especially in obese women and older women. This finding is strengthened by the statement of García-Niebla (2009), which stated that the placement of V1 and V2 precordial lead in women is not usually affected by the breast size, but for the placement of precordial electrodes, V4 –V5 breast size can be affected, because the position of V4 is in the breast position.

When placing standard ECG precordial lead on women, especially V4 and V5 precordial lead, are attached under the breast. In the ECG SafOne precordial lead, precordial lead is placed following the V1 position so that V4 and V5 precordial lead are placed above the breast. In a study conducted by Rautaharju et al. (1998, in Kania, 2014), breast size did not significantly contribute to any of the associations with ECG amplitude. The study does not support the idea that the protrusion of breast tissue changes the ECG amplitude. They recommend the placement of precordial lead on women above the breast according to the lead points. Conversely, Kligfield et al. (2007) recommend the placement of precordial lead on women under the breast. They stated that placing electrodes in front of the heart in women with large breasts remains problematic, and the electrodes are usually placed under the breast to reduce amplitude attenuation.

Both opinions above can theoretically be justified as long as the results of ECG recording can produce an accurate image. The precordial lead placement can be accurately placed in intercostal space by placing the electrodes above or under the breast (Drew, 2006). Based on Drew (2006), placing electrodes under the breast is recommended to avoid placing the electrodes as far as 2 cm or more from the correct point. Placing the precordial lead-up or down from the breast is not recommended because it can affect the ECG's R waves. Therefore, it can be concluded that the precordial lead can be placed above or below the breast, especially in women with large breasts and obese women.

BMI aspect in this study also becomes the consideration in determining the V1 position. During the study, we found that patients with normal and underweight BMI find the lead points, especially V1, more accessible than those with overweight and obese BMI. García-Niebla et al. (2009) suggested that for certain things, there will be difficulties in identifying anatomical points in obese or overweight patients, such as when ECG heart recording. This statement is also emphasized by Rautaharju et al. (1998), who stated that problems found in ECG measurement on obese patients are the uncertainty in placing the position of V4 precordial lads. Therefore, according to the results of the study obtained and related study, it can be stated that BMI can influence the position of precordial lead so that it can influence the time required in placing precordial lead.

The results of this study can be related to the previous study, which stated that ECG examination using ECG SafOne precordial lead is relatively faster than standard ECG (Dewi et al. 2020). However, the previous study does not explain the length of time required in ECG examination using ECG SafOne precordial lead.

Based on the Department of Health, State Government of Victoria (2020), ECG examination using standard ECG takes about 5 to 10 minutes. Thus, one of the initiations from the study by Dewi et al. (2020) expects that with the ECG SafOne precordial lead, the duration of electrocardiogram examination can be shorter. This result can be proven by data obtained, where the length of time for placing precordial electrodes using ECG SafOne precordial lead is faster than

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placing standard ECG precordial electrodes. Therefore, ECG SafOne precordial lead developed by Dewi et al. (2020) is expected to assist health workers in performing ECG recording quickly and accurately with a shorter duration of time.

4. Conclusion

This study revealed a significant difference in placement time duration of precordial lead from ECG SafOne and standard ECG. ECG SafOne finds valid points faster and places these precordial leads than standard ECG. Thus, precordial lead ECG SafOne is expected to advance healthcare professionals to provide service concerning conducting an ECG examination faster and precisely.

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