

Dyslipidaemia in patients with acute stroke at Da Nang C hospital, Vietnam

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ABSTRACT

Background: Stroke is a current medical issue in all countries worldwide. Currently, clinical characteristics and risk factors for developing acute stroke as well as dyslipidaemia have been identified.

Objectives: The research aimed to describe the status of dyslipidaemia in patients with acute stroke and the relationship between dyslipidaemia and certain clinical characteristics as also risk factors in patients with acute stroke at Da Nang C Hospital, Vietnam.

Methods: This retrospective cross-sectional study analysed 197 medical records of acute stroke patients at Da Nang C Hospital, Vietnam (February 2023-March 2024). Data collected included demographics (age, gender, height, weight), hypertension (systolic BP ≥ 140 mmHg, diastolic BP ≥ 90 mmHg), and lipid profiles (TC ≥ 5.2 mmol/L, triglycerides ≥ 1.7 mmol/L, LDL-C ≥ 3.4 mmol/L, HDL-C < 0.9 mmol/L in males, < 1.1 mmol/L in females). Statistical analyses were conducted using SPSS version 25.0 and Microsoft Excel 2016. Chi-square tests and odds ratios were calculated, with statistical significance set at $P < 0.05$.

Results: The percentage of dyslipidaemia in patients with stroke was 80.2%, with low HDL-C (52.3%) and high triglycerides (45.7%) being the most common abnormalities. Dyslipidaemia was more prevalent in the ischemic stroke group (98.1%) compared to the haemorrhagic stroke group with a 95% confidence interval (CI) of 1.26 – 27.58 (P -value = 0.030). The proportion of dyslipidaemia in stroke patients increases with age, with the highest rate observed in the 65-74 age group (38.4%). Stroke patients with dyslipidaemia also have a higher prevalence of hypertension (74.1%, 95% CI: 1.07 – 4.56), diabetes (41.1%, 95% CI: 1.04 – 5.23), and obesity (51.9%); with P -value 0.034, 0.043, and 0.860 respectively.

Conclusion: Patients with acute stroke often have dyslipidaemia, with the majority of cases characterized by decreased HDL-C levels and increased triglycerides. This tends to increase gradually with age.

Keywords: Acute stroke, Clinical characteristics, Dyslipidaemia, Risk factors

1. Introduction

Stroke is consistently a critical issue in the healthcare sectors globally [1]. It is the third leading cause of death, following cardiovascular disease and cancer, and ranks as the foremost cause of neurological disorders [2].

In recent years, despite significant advancements in the diagnosis and treatment, stroke encompass 16 million cases annually and 6 million deaths. According to the World Stroke Organization (2022), there are over 12.2 million new stroke cases worldwide each year. In Vietnam, *Thanh* reported that there are over 200,000 new stroke patients annually, with approximately 100,000 fatalities [2].

Hyperlipidaemia is one of the significant risk factors for vascular diseases in general and stroke in particular. Dyslipidaemia increases total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-C) levels in the blood, leading to the accumulation and development of atherosclerotic plaques in the arterial walls. Over time, these plaques can cause blockages, depriving the brain from the necessary blood supply, which may lead to necrosis, significantly increase the risk of ischemic stroke or haemorrhagic stroke [3-5]. According to the research by *Chinh*, the

prevalence of dyslipidaemia in stroke patients was 58.6% [5].

When discussing risk factors for stroke and dyslipidaemia, studies often highlight factors such as hypertension, diabetes mellitus, or overweight and obesity. Dyslipidaemia contributes to increased deposition of atherosclerotic plaques, causing arterial narrowing and, consequently, hypertension [6]. Furthermore, stroke is associated with abnormalities in plasma lipoprotein metabolism. In diabetic patients, hypertriglyceridemia frequently occurs due to decreased lipoprotein lipase activity [7]. Additionally, overweight and obesity lead to increased visceral fat, which can result in hypertension and myocardial infarction [8].

Identifying acute stroke patients and assessing dyslipidaemia along with its clinical features and risk factors at Da Nang C Hospital in Vietnam is crucial for preventing the adverse outcomes and complications of this condition.

2. Methods

2.1 Study Area

The study was conducted at the Stroke Department at Hospital C in Da Nang, Vietnam.

2.2 Study Design

The research used the retrospective and cross-sectional method, which was conducted at the Department of Stroke, C Da Nang Hospital, Vietnam from February 2023 to March 2024. The data were collected through medical records of patients diagnosed with cerebral stroke based on clinical and paraclinical findings, as well as appropriate diagnostic tests.

2.3 Sample Size and Sampling

We used the formula:

$$n = \frac{Z^2 p(1-p)}{d^2}$$

Where:

n: Minimum required sample size for the study.

Z: Confidence coefficient at a 95% confidence level ($\alpha = 0.05$) corresponding to $Z = 1.96$.

d: Acceptable margin of error. We chose $d = 0.05$.

p: Proportion of dyslipidaemia in acute stroke patients with dyslipidaemia, which was 85%, according to the study by Bay [9]. Thus, $p = 0.85$.

$$n = \frac{1.96^2 \times 0.85(1-0.85)}{0.05^2} = 195.9$$

The minimum sample size calculated using the formula is 196. In practice, the study was conducted on 197 patients.

A total of 197 medical records of patients matching the diagnostic criteria were collected at the Department of Stroke, C Da Nang Hospital, Vietnam. Clinical and paraclinical results were collected according to the information on the survey form. Data processing and analysis were performed.

Inclusion criteria included patients over 18 years old who met the diagnostic criteria and had visited or been admitted to Da Nang C Hospital with a clinically and preclinically confirmed diagnosis of stroke.

Exclusion criteria included stroke patients who did not consent to participate in the study, lack sufficient research data, or had been previously diagnosed with and were currently on treatment for dyslipidaemia at the time of data collection.

We collected data using pre-designed collection forms. The information in these forms included: demographic information (age, gender, height, weight); disease-related information (systolic blood pressure, diastolic blood pressure); blood lipid test index (Total cholesterol, triglycerides, LDL-C, HDL-C).

Patients were diagnosed with dyslipidaemia when they satisfy at least one of the following criteria: Total cholesterol (TC) ≥ 5.2 mmol/L or LDL-C ≥ 3.4 mmol/L or Triglycerides (TG) ≥ 1.7 mmol/L or HDL-C < 0.9 mmol/l in males and HDL-C < 1.1 mmol/l in females [10]. Some related factors in people with stroke were recorded on the survey form: age, gender, diastolic blood pressure, diabetes, Body Mass Index (BMI). The formula to calculate BMI was based on 2 indicators: height and weight: $BMI = \text{Weight} / [(\text{Height})^2]$. In which, height is in meters (m) and weight is in kilograms (kg). BMI does not apply to pregnant women, athletes, or bodybuilders. Based on the classification scale of Integrated Discrimination Improvement (IDI) & Western Pacific Region (WPRO) for Asians, the ideal BMI of Vietnamese people is from 18.5 to 22.9; overweight is from 23 – 24.9; Grade I obesity is from 25 – 29.9; and Grade II obesity is greater than or equal to 30 [11]. We classified hypertension according to the 2020 International Society of Hypertension (ISH) global guidelines for the clinical practice of hypertension. Hypertension was diagnosed when a person has an office-measured systolic blood pressure (SBP) of ≥ 140 mmHg and/or a diastolic blood pressure (DBP) of ≥ 90 mmHg after repeated testing.

Or the patient had been diagnosed and was being treated for high blood pressure [12]. Diabetes was classified according to 2022 American Diabetes Association criteria: HbA1c $\geq 6.5\%$, fasting plasma glucose ≥ 126 mg/dL (7.0 mmol/L) after 8-hour fast, 2-hour plasma glucose ≥ 200 mg/dL (11.1 mmol/L) during OGTT with 75g glucose, or random plasma glucose ≥ 200 mg/dL (11.1 mmol/L) with hyperglycaemic symptoms (excessive thirst, frequent urination, unexplained weight loss). Diagnosis required two consecutive positive laboratory results unless clear clinical symptoms with significantly elevated glucose were present. [13].

2.4 Data Collection

2.4.1 Data collection processes

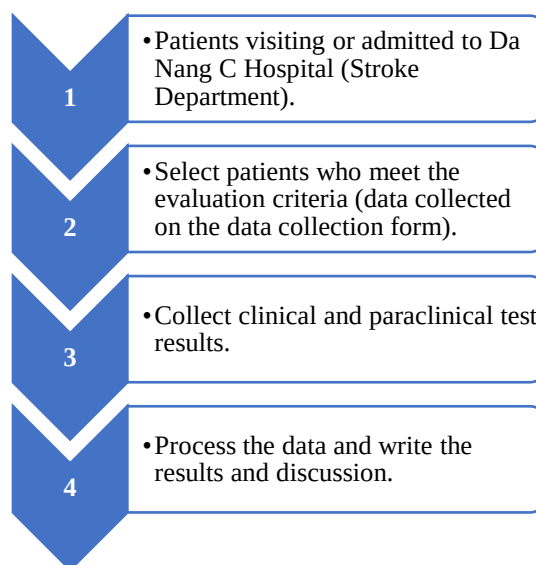


Figure 1: Data collection processes

2.4.2 Measures to Ensure Data Quality in Scientific Research:

Developing a clear data collection plan:

We created a detailed plan outlining data collection methods, time, location, and research subjects, ensuring that the methods align with the research objectives.

We also designed questionnaires and data collection forms, conducting a pilot study on a small group of subjects to evaluate the feasibility, reliability, and accuracy of the tools.

Data was carefully recorded to avoid omissions or errors. Collected data was reviewed to identify errors or abnormal values. Data cleaning was performed by removing incomplete, invalid, or erroneous data. Software such as SPSS and Excel was used for data entry and analysis. Personal data of research subjects was kept confidential and only used for research purposes. Data was stored in a secure location with restricted access. Expert opinions in the relevant research field were sought to ensure that the processes and data complied with scientific standards. Data collection and processing methods were clearly presented in the report. Any factors that could affect data quality, if present, were fully disclosed. Implementing these measures

enhances the reliability and value of the data, thereby ensuring the quality and accuracy of the research results

2.5 Data Analysis

We used Excel 2016 to enter and compile research data from research forms and information from patients' health examination forms. The data were stored in Excel and analysed using SPSS software version 25.0.

SPSS 25.0 software was used to analyse data, using descriptive statistics to analyse data. Qualitative variables presented as frequencies and percentages. Quantitative variables used to describe variables according to the law of normal distribution, use the mean and standard deviation ($X \pm SD$). We use the Chi-square test (χ^2) adjusted with Fisher's exact test when appropriate. T-test, test comparing two proportions. Compare and analyse the ratios and calculate the odds ratio OR. Risk factors are calculated by the odds ratio OR with a 95% confidence level.

3. Results

Characteristics of the participants and dyslipidaemia in the research population

In the research of 197 patients, males accounted for 48.7% and females accounted

for 51.3%. The most common type of stroke was ischemic stroke, accounting for 96.4% of cases. Additionally, the research found that the incidence of stroke tended to increase with age, specifically in the age groups of 18-54 (17.3%), 55-64 (21.8%), and 65-74 (34.5%), with the highest incidence observed in the 65-74 age group (34.5%). Regarding risk factors, the research showed that hypertension was the most prevalent factor (70.6%), followed by obesity (52.3%), and diabetes (37.6%).

In the research, particularly 197 patients, the prevalence of dyslipidaemia in the study was 80.2%. The most common type of dyslipidaemia was single-component disorder, accounting for 32.0%, while the least common was three-component disorder, accounting for 10.2%. Regarding the proportion of dyslipidaemia indices, the highest was decreased HDL-C (52.3%) and increased triglycerides (45.7%); increased TC accounted for 38.1%, while the lowest was increased LDL-C (28.9%) (see Table 1).

Table 1: Characteristics of the participants and dyslipidaemia in the research population (n=197)

Characteristics	Number (n)	Percentage (%)
Cerebral stroke		
Ischemic stroke	190	96.4
Haemorrhage stroke	7	3.6
Gender		
Male	96	48.7
Female	101	51.3
Age		
18 - 54	34	17.3
55 - 64	43	21.8
65 - 74	68	34.5
≥ 75	52	26.4
Risk factors		
Hypertension	139	70.6
Diabetes	74	37.6
Obesity	103	52.3
Dyslipidaemia		
Disorder	158	80.2
Normal	39	19.8
Number of blood lipid components disorders		
Disorder of a single component	63	32.0
Disorder of a two component	48	24.4
Disorder of a three component	20	10.2
Disorder of a four component	27	13.7
Blood lipid index disorder		
Total Cholesterol	75	38.1
Triglycerides	90	45.7
LDL-C	57	28.9
HDL-C	103	52.3

The most common lipid disorder index was reduced HDL-C (52.3%) with an average value of 1.23 ± 0.84 mmol/L, followed by elevated TG (45.7%) with an average value of 1.74 ± 0.79 mmol/L. Then, followed by elevated TC (38.1%) with an average value

of 4.76 ± 1.28 mmol/L, and the least common is elevated LDL-C (28.9%) with an average value of 2.73 ± 0.98 mmol/L. The percentage of disorders of each lipid component were shown in Table 2.

Table 2: The average value of each abnormal blood lipid component in the research population (n=197)

Characteristic		Number (n)	Percentage (%)	$\bar{X} \pm SD$ (mmol/L)
Total Cholesterol	Normal	122	61.9	4.76 ± 1.28
	Disorder	75	38.1	
Triglycerides	Normal	107	54.3	1.74 ± 0.79
	Disorder	90	45.7	
LDL-C	Normal	140	71.1	2.73 ± 0.79
	Disorder	70	28.9	
HDL-C	Normal	94	47.7	1.23 ± 0.84
	Disorder	103	52.3	

The Relationship Between Dyslipidaemia and Clinical Characteristics and Risk Factors

Among 197 participants under medical care, we observed that 158 patients had dyslipidaemia, accounting for 98.1% in the ischemic stroke group and 1.9% in the haemorrhagic stroke group. The proportion of patients with dyslipidaemia in the ischemic stroke group is 5.91 times higher than in the haemorrhagic stroke group, with a 95% confidence interval (CI) of 1.26 – 27.58 ($P < 0.05$).

Regarding risk factors, research has found that 74.1% of patients with hypertension have dyslipidaemia. The proportion of patients with dyslipidaemia in the hypertension group

is 2.21 times higher than in the non-hypertension group, with a 95% CI of 1.07 – 4.56. Additionally, the study recorded that 41.1% of patients with diabetes have lipid disorders. The proportion of lipid disorders in the non-diabetic group is 2.33 times higher than in the diabetic group, with a 95% CI of 1.04 – 5.23. In addition, the proportion of dyslipidaemia tends to increase with age, with the respective age groups being 18-54 (14.0%), 55-64 (22.8%), and 65-74 (34.7%). The average age in the group of patients with lipid disorders is 67.57 ± 12.85 . The research found a significant association between dyslipidaemia and stroke, age group, hypertension, and diabetes ($P < 0.05$).

Among the total number of cases with dyslipidaemia, males accounted for 49.4% and females accounted for 50.6%. The proportion of dyslipidaemia individuals with obesity in the acute stage of stroke was

51.9%. However, the difference in the prevalence of dyslipidaemia between genders and obesity status was not statistically significant ($P > 0.05$) (see Table 3).

Table 3: The relationship between dyslipidaemia and clinical characteristics and risk factors (n=197)

Factors	Dyslipidaemia		No Dyslipidaemia		OR (95% CI) *	P-value**
	Number (n)	Percentage (%)	Number (n)	Percentage (%)		
Cerebral stroke						0.030
Ischemic stroke	155	98.1	35	89.7	1	
Haemorrhage stroke	3	1.9	4	10.3	5.91 (1.26 – 27.58)	
Age						0.045
18 – 54	22	14.0	12	30.8	1	
55 – 64	36	22.8	7	17.9	1.35 (0.54 – 3.31)	
65 – 74	55	34.7	13	33.4	1.09 (0.52 – 2.30)	
≥ 75	45	28.5	7	17.9	1.82 (0.74 – 4.42)	
Gender						0.725
Male	78	49.4	18	46.2	1	
Female	80	50.6	21	53.8	0.88 (0.44 – 1.78)	
Risk factors						
Hypertension	117	74.1	22	56.4	2.21 (1.07 – 4.56)	0.034
Diabetes	65	41.1	9	23.1	2.33 (1.04 – 5.23)	0.043
Obesity	82	51.9	21	53.8	1.08 (0.54 – 2.18)	0.860

* Significance for the test was Adjusted OR

**Significance for the test was determined at p-value < 0.05

4. Discussion

General Characteristics of the Research Population

The research conducted on 197 patients showed that the incidence of ischemic stroke was significantly higher than the incidence of haemorrhagic stroke. This result is consistent

with many other articles, such as Tien, which reported a higher incidence of ischemic stroke (70%) compared to haemorrhagic stroke (30%) [2]; the research by A.C. *et al* cerebral infarction accounts for 76% of cases [14]. According to the findings of Martin *et al* the cerebral infarction group (77.3%) has a

higher prevalence than the cerebral haemorrhage group (22.7%) [15].

The proportion of stroke patients is higher in females, accounting for 51.3%, compared to males at 48.7%. This result differs from the findings of A.C. et al which reported 58% for males and 42% for females [14]; The authors Afridi et al reported a prevalence of 55.6% in males and 44.4% in females. The majority of women may have a higher proportion due to endocrine disorders or hormonal changes during pregnancy [16].

In the research, there is an increasing trend of stroke occurrence according to age groups. The prevalence of stroke in the age groups 18-54, 55-64, and 65-74 was 17.3%, 21.8%, and 34.5% respectively. This trend is similar to the findings of Tien specifically in the age groups 51-60, 61-70, and 71-80, with prevalence rates of 20%, 28%, and 34% respectively [2]. However, *Thu et al* found a decreasing trend, specifically in the age groups 60-69, 70-79, and above 80, with percentages of 39.4%, 31.4%, and 29.2% respectively [17]. In addition, the highest incidence of stroke was found in the age group of 65-74, accounting for 34.5%. This finding is consistent with the study conducted by *Chinh* where the highest proportion was also observed in the age group of 65-74

(31%) [5]. The prevalence of hypertension among stroke patients in the research was the highest (70.6%), followed by diabetes (37.6%) and obesity (52.3%). These findings are consistent with the study conducted by *Hang et al* which reported that hypertension was the leading risk factor, accounting for 87.2%, followed by diabetes at 39.3% [18]. The results of the research by Ali et al also identified hypertension as the main risk factor (75%), followed by diabetes (49%) and obesity (11%) [19]. However, there was a discrepancy in the prevalence of overweight individuals (52.3%) compared to 11%. This can be explained by the fact that the research will be based on the BMI classification criteria for Asians to categorize the subjects, with obesity being classified as $\geq 23 \text{ kg/m}^2$; while the classification criteria used in the major Ali et al is using a BMI of $\geq 30 \text{ kg/m}^2$ [19].

Characteristics of Dyslipidaemia in the Study Population

Among 197 participants, it was found that patients with dyslipidaemia accounted for 80.2% of the total, which was much higher than the patients without dyslipidaemia (19.8%). These results are consistent with previous researches [5, 20].

The study on the prevalence of stroke-related disorders found that the highest proportion of stroke patients had at least a single component of disorders (32%). This was followed by patients with two components of disorder (24.4%), four components of disorder (13.7%), and three components of disorder (10.2%). The variation in the proportions of these four components may be attributed to lifestyle factors such as smoking, alcohol addiction, hypertension, and diabetes, which increase the risk of developing these disorders [17].

In this study, the most commonly encountered dyslipidaemia was decreased HDL-C (52.3%) and increased triglycerides (45.7%). These findings are consistent with the study conducted by *Bruno et al* where the two highest proportions were observed for decreased HDL-C (44.2%) and increased triglycerides (34.7%) [21]. However, it differs from the study conducted by *Thu et al* which reported a common occurrence of decreased HDL-C (45.7%) and increased LDL-C (44.7%) and the major by *A.C. et al* reported a significant increase in LDL-C (57%) and a decrease in HDL-C (48%), which accounted for the highest proportion [14, 17]. The reason for this difference may be due to variations in selecting the standard

threshold values for diagnosing dyslipidaemia. An increase in one or more lipid profile parameters in blood tests can lead to dyslipidaemia, which can cause obesity, diabetes, and hypertension [4]. Therefore, the results of lipid blood screening have always been and continue to be a useful tool in aiding early treatment and prevention of related conditions such as hypertension, diabetes, and obesity.

In addition, the study results recorded the average values of the four indices as follows: TC (4.76 ± 1.28 mmol/L), TG (1.74 ± 0.79 mmol/L), LDL-C (2.73 ± 0.98 mmol/L), and HDL-C (1.23 ± 0.84 mmol/L). These results are quite similar to those of *Ali et al*, which were TC (4.22 ± 1.120 mmol/L), LDL-C (2.97 ± 0.864 mmol/L), HDL-C (1.094 ± 0.396 mmol/L), and TG (1.51 ± 0.69 mmol/L) [19].

Although the results vary, it can be observed that the most common conditions were elevated TG and reduced HDL-C. TG levels are often elevated in stroke patients and are considered one of the leading risk factors contributing to atherosclerosis, which in turn leads to ischemia. Insufficient blood supply to the brain deprives the affected area of oxygen and nutrients, preventing it from maintaining normal function and survival.

Stroke is the leading cause of death among neurological disorders [2-5].

An increase in one or more lipid indices in lipid profile tests can lead to dyslipidaemia, which contributes to overweight/obesity, atherosclerosis, diabetes, and hypertension [4]. Therefore, screening results from lipid profile tests have always been a valuable tool in early treatment and prevention of related diseases.

The Relationship Between Dyslipidaemia and Clinical Characteristics and Risk

The research findings indicated a correlation between stroke and dyslipidaemia. The study showed that the prevalence of dyslipidaemia was higher in the ischemic stroke group (98.1%) compared to the haemorrhagic stroke group (1.9%). These results were consistent with the findings of Chinh where the prevalence of dyslipidaemia was 65.7% in the ischemic stroke group and 48.5% in the haemorrhagic stroke group and *Anthonia et al* reported that 85% of patients with ischemic stroke had dyslipidaemia, while 75% of patients with haemorrhagic stroke had dyslipidaemia [5, 22].

The prevalence of stroke patients with dyslipidaemia tends to increase with age. This was consistent with the findings of *Thu*

et al where the corresponding rates for the age groups above 80, 70 - 79, and 60 - 69 were 80%, 76.3%, and 54.1% respectively [17]. The possible causes may be due to a decrease in the process of lipoprotein metabolism and clearance in the serum, or when the blood vessels become hardened and narrowed with age, as well as an increased susceptibility to chronic diseases [16, 23].

This study did not find any correlation between gender and the presence of dyslipidaemia. The proportion of individuals with dyslipidaemia among stroke patients was equal in females (50.6%) and males (49.4%). This result was consistent with the findings of *Afridi et al* where 51.6% of stroke patients had dyslipidaemia, with males accounting for 53.8% and females accounting for 46.2% [20].

Hypertension is one of the major risk factors for assessing dyslipidaemia. Dyslipidaemia increases the formation of atherosclerotic plaques and causes narrowing of the arteries, resulting in elevated blood pressure [6].

In this study, a correlation was observed between diabetes and dyslipidaemia. Diabetes often causes an increase in blood triglycerides due to decreased activity of the enzyme lipoprotein lipase [7].

Although, the research did not find any correlation between obesity and dyslipidaemia, obesity is a crucial factor that needs to be monitored and evaluated for the risk assessment of stroke. Obesity leads to increased visceral fat, elevated hypertension, and coronary artery disease [8]. The causes of obesity may originate from the patient's diet and lifestyle. Therefore, adults should regularly screen lipid profiles to detect early signs of dyslipidaemia, thereby helping to prevent potential complications.

5. Conclusion

The prevalence of dyslipidaemia in patients with stroke is high, with low HDL-C and high triglycerides being the most common abnormalities. Dyslipidaemia in ischemic stroke was higher than in haemorrhagic stroke. The study subjects with dyslipidaemia were most frequently found with advancing age, having hypertension and having diabetes. Dyslipidaemia was also observed in majority subjects who were overweight or obese. No association was found between dyslipidaemia and gender, or between dyslipidaemia and obesity.

We propose recommendations for effective disease prevention, such as implementing screening programs for individuals over 30

years old, as stroke is increasingly affecting younger populations, or adopting preventive measures to control lipid disorders in high-risk groups, such as the elderly and individuals with the risk factors mentioned in this study.

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Author contributions

VTA: Conceptualization, data curation, formal analysis, methodology, writing original draft, writing review and editing.
HTNA: Conceptualization, methodology, supervision, writing original draft, writing review and editing.

Declaration

Ethics approval and consent to participate

This study was conducted following ethical approval from the Ethics Committee in Biomedical Research at Da Nang University of Medical Technology and Pharmacy, established under Decision No. 548/QĐ-ĐHKTYĐĐN dated September 29, 2023. Based on meeting minutes No. 79/BB-

Patients were clearly explained the purpose and significance of the study; the patients who agreed to participate in this study voluntarily signed the consent form. In addition, patients have the right to refuse or stop participating in the study at any time they wish. The research process does not interfere with treatment and care at all.

Patients are fully respected, and their personal information is confidential.

Competing interests

None

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