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ELECTROLYTE DISORDERS IN PATIENTS UNDERGOING CHRONIC HEMODIALYSIS AT THAI BINH UNIVERSITY HOSPITAL

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ABSTRACT

Objective: To describe the clinical characteristics and sodium and potassium disorders in patients undergoing chronic hemodialysis at Thai Binh University Hospital before dialysis sessions in 2024.

Method: A prospective, cross-sectional descriptive study was conducted with 84 patients undergoing chronic hemodialysis. Data were collected through interviews, clinical examinations, and laboratory tests. Statistical analysis was performed using SPSS 20.0.

Results: The male-to-female ratio was 1.16:1. The prevalence of ESRD increased with age, peaking in those aged over 65 years (29.8%). Chronic glomerulonephritis and pyelonephritis were the leading causes (61.9%). The most common symptoms were fatigue (69.0%) and pale skin (83.3%). The prevalence of mild hyponatremia was 20.2%, with an average sodium concentration of 129.29 ± 3.22 mmol/L. Hyperkalemia was observed in 37.9% of patients, with severe cases accounting for 32.3%. A total of 46.4% of patients showed no electrolyte disorders, while 44.0% had one disorder, and 9.6% had two.

Conclusion: Fatigue, edema, and dyspnea were common symptoms among patients with ESRD. Electrolyte disorders, particularly mild hyponatremia and hyperkalemia, are frequently observed. Early diagnosis and management are crucial to reducing complications and improving patient outcomes.

Keywords: *Electrolyte disorders, chronic hemodialysis, sodium disorders, potassium disorders, Thai Binh University Hospital*

Introduction

End-stage renal disease (ESRD) represents the final and most severe stage of chronic kidney disease (CKD), characterized by a glomerular filtration rate (GFR) below 15 ml/min/1.73 m². Without timely intervention, ESRD leads to severe complications or death. Hemodialysis is the most commonly employed renal replacement therapy [1].

Electrolyte disorders, particularly sodium and potassium imbalances, are frequent complications in ESRD patients undergoing hemodialysis. These imbalances can exacerbate comorbidities, such as cardiovascular diseases, and significantly affect patient quality of life. However, clinical manifestations of electrolyte disorders are often absent or mild despite abnormal laboratory findings [2].

This study aims to describe the clinical characteristics and sodium and potassium disorders in patients undergoing chronic hemodialysis at Thai Binh University Hospital before dialysis sessions.

II. Subjects and research methods

2.1. Subjects, Location and Duration of the research

2.1.1. Research Subjects

Inclusion criteria:

"Patients diagnosed with ESRD who underwent chronic hemodialysis at the Hemodialysis Department of Thai Binh Medical University Hospital."

+ Patients who are over 16 years old

+ Patients who agree to attend the research

Exclusion criteria

+ Patients have ESRD combined with other diseases causing electrolyte disorders such as cirrhosis, diarrhea,...

2.1.2. Research location: Research was conducted at the Hemodialysis Department of Thai Binh Medical University Hospital, Thai Binh University of Medicine and Pharmacy

2.1.3. Research Duration: The research period was from September 2023 to September 2024

2.2. Research Methodology

2.2.1. Research Design: A descriptive cross-sectional, prospective study

2.2.2. Sample Size and Sampling Method

- Sample size: using the following formula:

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Whereas:

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

n: sample size

Z: Confidence Interval based on α, choose α = 0.05, we have Z = 1.96.

d: margin of error, choose d = 0.08.

p: The proportion of patients having electrolyte disturbance

- Sampling method: Convenience sampling method. Our research team selected patients based on inclusion and exclusion criteria from the 1st May,2024 to the 1st June, 2024

2.2.3. Research Indicators

+ General characteristics: Age, gender, causes of ESKD

+ Clinical characteristics: Symptoms (subjective and objective)

+ Paraclinical characteristics: Blood levels of Na+, K+, Urea, Creatinine, complete blood count (CBC), glomerular filtration rate (calculated using the CKD-EPI 2009 formula).

2.2.4. Diagnostic Criteria Used in the Study

+ Diagnostic standard for ESRD: According to KDIGO 2012 guidelines [3].

+ Diagnostic standard and grading of sodium and potassium disturbance: According to the Ministry of Health 2015 standards [1].

+ Diagnostic standard for hypertension: Based on JNC VI classification [4].

2.3. Data Collection and Processing

2.3.1. Data Collection Method: Patients were interviewed and underwent a comprehensive clinical examination. Blood samples were taken after fasting during the first dialysis session of the week. For patients undergoing hemodialysis on Mondays, Wednesdays, and Fridays, blood was drawn before the dialysis session on Monday. For patients undergoing hemodialysis on Tuesdays, Thursdays, and Saturdays, blood was drawn before the dialysis session on Tuesday.

2.3.2. Data Processing: The data were entered and processed using SPSS 20.0.

2.4. Ethical Considerations: The study was approved by the Scientific Committee of Thai Binh University of Medicine and Pharmacy No. 1695/ QD-YDTB. All information was collected with the voluntary consent and cooperation of the patients. Patient information was kept confidential.

III. RESULTS

Table 1. General Characteristics of Patients (n = 84)

Variable	n	%
Gender		
Male	45	53.6
Female	39	46.4
Age		
16-25	2	2.4
26-35	8	9.5
36-45	12	14.3
46-55	17	20.2
56-65	20	23.8
>65	25	29.8
Causes of ESRD		
Chronic glomerulonephritis, chronic pyelonephritis	53	61.9

Variable	n	%
Urinary stones	10	11.9
Hypertension	3	3.6
Hyperglycemia	6	7.1
Systemic Lupus Erythematosus	2	2.4
Polycystic Kidney Disease	3	3.6
Forget or unidentified	7	9.5

ESRD prevalence increases with age, with the highest proportion (29.8%) found in patients aged >65 years.

Chronic glomerulonephritis and chronic pyelonephritis were the leading causes of ESRD, accounting for 61.9% of cases.

Table 2: Clinical Characteristics of research subjects (n=84)

Subjective Symptoms	n	%	Objective Symptoms	n	%
Fatigue	58	69.0	Pale Skin	70	83.3
Nausea, vomiting	21	25.0	Edema	49	58.3
Headache	9	10.7	Hypertension	61	72.6
Chest pain	1	1.2	Hemorrhage	2	2.4
Loss of appetite	35	41.7			
Muscle Cramp	4	4.8			
Tingling	5	5.9			
Heart palpitation	8	9.5			

Fatigue (69.0%) and pale skin (83.3%) were the most commonly observed symptoms, highlighting the impact of anemia and uremic toxins in ESRD patients.

Edema and hypertension, both significant complications of kidney disease, were also frequently observed.

Table 3. Characteristics of Sodium and Potassium Blood Levels in the Research Subjects (n=84)

Index (mmol/l)			n	%	X±SD
Sodium	[Na+] < 135	Severe: [Na+] < 110	0	0	0
		Moderate: 110 ≤ [Na+] ≤ 120	0	0	0
		Mild: 120≤ [Na+] < 135	17	20.2	129.29±3.22
	135 ≤ [Na+] ≤145		62	73.8	139.37±2.90
	[Na+] > 145		5	6.0	147.2±1.31
Potassium	[K+] < 3.5		0	0	0
	3.5 ≤ [K+] ≤ 5		53	63.1	4.60±0.32
	[K+] > 5	Severe: [K+] > 6	10	32.3	6.35±0.401
		Moderate: 5.5 < [K+] ≤ 6	8	25.8	5.65±0.07
		Mild: 5.0 < [K+] ≤5.5	13	41.9	5.31±0.14

Mild hyponatremia was observed in 20.2% of patients, while hyperkalemia occurred in 37.9% of cases, highlighting the common electrolyte imbalances in ESRD.

Severe hyperkalemia poses significant risks, such as arrhythmias, emphasizing the importance of timely intervention.

Table 4: Distribution of electrolyte disturbance based on GFR (n=84)

Index (mmol/l)		GFR (ml/min/1,73m²)				p
		< 5 (n=53)		5 – 10 (n=31)		
		n	%	n	%	
Sodium	[Na+] < 135	11	20.8	6	19.4	> 0.05
	135 ≤ [Na+] ≤145	41	77.4	21	67.7	
	[Na+] > 145	1	1.8	4	12.9	
Potassium	3,5 ≤ [K+] ≤ 5	30	56.6	23	74.2	> 0.05
	[K+] > 5	23	43.4	8	25.8	

Hyponatremia and hyperkalemia were more prevalent in patients with GFR < 5 mL/min/1.73 m².

Although GFR decline correlates with increased electrolyte disturbances, variations in individual compensatory mechanisms may explain some discrepancies.

IV. DISCUSSION

In our research, the male-to-female ratio of patients with the disease was almost equal (1.16/1). The research also showed that ESRD occurs in all adult age groups, with a progressive increase in the number of patients in older age groups. Among the 84 patients, 53 of whom had causes such as chronic glomerulonephritis and chronic pyelonephritis (61.9%), followed by urinary stones at 11.9%. Other causes accounted for less than 10%.

Fatigue was the most common symptom in our research, occurring in 69.04% of patients. Fatigue can result from multiple factors, including the accumulation of uremic toxins, anemia, electrolyte imbalances, and other metabolic disorders due to the kidneys' inability to filter blood effectively. Due to the limitations of the study's scope, we only evaluated symptoms before hemodialysis. However, after regular dialysis, fatigue did not completely disappear but improved only partially. Patients frequently complained of fatigue after dialysis sessions [5]. It is important to clarify whether persistent fatigue before dialysis differs from fatigue after dialysis and how it differs. Understanding the factors related to fatigue can help the clinicians identify dialysis patients at higher risk of fatigue and implement interventions to alleviate it.

The clinical symptoms of sodium and potassium imbalances, such as nausea, vomiting, palpitations, tingling, and neurological symptoms, were quite minimal in our research, similar to previous studies that have shown that patients often do not exhibit clear symptoms when electrolyte imbalances occur. However, severe deficiencies in sodium and potassium can lead to serious complications if not detected and managed in a timely manner. This highlights the importance of closely monitoring and promptly correcting electrolyte levels during hemodialysis treatment.

Anemia: Manifested by pale skin, anemia was the most common sign in our research patients (83.33%). This suggests that the prevalence of anemia among patients with ESRD undergoing cyclic hemodialysis is very high. Therefore, treatment with erythropoiesis-stimulating agents, along with iron supplementation and nutritional management, are essential measures to improve anemia and enhance the quality of life for these patients. In addition, controlling inflammation and addressing other factors contributing to anemia should be prioritized during treatment.

Hypertension: Hypertension is also a common clinical symptom in chronic kidney disease. This finding is consistent with the results of many other researches. Hypertension is both a cause and a consequence of chronic kidney disease. It also accelerates the process of glomerulosclerosis, hastening the progression of kidney failure. This symptom tends to persist and is difficult to control. Additionally, hypertension causes many complications in other organs such as the brain, heart, and blood vessels. Therefore, monitoring

blood pressure is crucial in the treatment of ESRD to help slow the progression of the disease.

In our research, the average sodium concentration in patients was 137.8 ± 5.449 mmol/L, with a 20.2% incidence of hyponatremia, all of which were classified as mild. This result is consistent with the research of Dang Thi Viet Ha [6]. Studies agree that mild hyponatremia is the most common form of sodium imbalance in patients with ESRD undergoing cyclic hemodialysis. The causes of hyponatremia in these patients may include a low-salt diet, medication use, and renal dysfunction.

There are some limitations in our research that should be mentioned. First of all, blood glucose levels were not available for all patients. Blood glucose can affect plasma osmolality, particularly in diabetic patients, which in turn influences sodium levels. Secondly, the causes of hyponatremia were not comprehensively assessed. In addition, malnutrition and inflammation are linked to a higher risk of hyponatremia, while fluid overload is associated with a lower likelihood of hyponatremia.

In our research, the average potassium concentration was 5.02 ± 0.679 mmol/L, with 37.9% of patients exhibiting hyperkalemia. Among these, 41.9% had mild hyperkalemia, 25.8% had moderate hyperkalemia, and 32.3% had severe hyperkalemia. These results are similar to those of Dang Thi Viet Ha [6] and Pham Minh Hung et al [2]. As glomerular filtration rate (GFR) decreases, the kidneys' ability to excrete potassium also declines, leading to elevated potassium levels in the blood.

The subjects in our research were patients who had been undergoing cyclic hemodialysis for many years, so the average GFR was 4.94 ± 1.63. The proportion of chronic kidney disease patients with a GFR < 5 was 63.09%, 36.9% had a GFR between 5-10, and no patients had a GFR between 10-15. When comparing the rates of sodium and potassium imbalances across these two GFR groups, our results showed that the group with a GFR <5 had a higher incidence of hyponatremia and hyperkalemia than the group with a GFR between 5-10. These findings are consistent with other studies. However, our study did not identify a clear correlation between GFR and sodium or potassium imbalances. This difference could be attributed to various factors, such as physiological compensatory mechanisms and the individual characteristics of each patient. The most significant factor, however, may be the limited sample size in our research.

V. CONCLUSION

The commonly encountered clinical manifestations include fatigue (98%), edema (54%), and dyspnea (48%), which reflect the extent of electrolyte disturbances and end-stage chronic kidney disease. Electrolyte imbalances frequently observed in patients with ESRD undergoing regular hemodialysis typically involve mild hyponatremia and hyperkalemia. Notably, the clinical symptoms of electrolyte disturbances often do not correlate directly with the laboratory findings. Therefore, early identification of electrolyte abnormalities, along with timely interventions such as pharmacological management, dialysis, and tailored nutritional counseling, is crucial to mitigate the risk of severe complications.

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THE REVIEW ON BIOLOGICAL ACTIVITIES OF ENT-KAURANE DITERPENOIDS EXTRACTED FROM CROTON TONKINENSIS

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ABSTRACT

Objective: *Croton tonkinensis* has been a focal point of medicinal research due to its rich phytochemical composition, particularly ent-kaurane diterpenoids. These compounds exhibit diverse biological activities, including anticancer, anti-inflammatory, anti-microbial, and osteogenic effects, which are explored in this review. We summarize extraction techniques, structural properties, and recent findings on their pharmacological potential, offering a foundation for future research on therapeutic applications.

Method: The study focuses on retrieving articles from PubMed, Scopus, and Web of Science using the keyword *"Croton tonkinensis"*. The collected articles are analyzed to extract and summarize critical information related to the extraction processes, chemical structures, and biological activities of ent-kaurane diterpenoids isolated from *Croton tonkinensis*. Based on these findings, the research evaluates potential practical applications of these compounds and explores future research directions for *Croton tonkinensis*.

Results: Ent-kaurane diterpenoids extracted from *Croton tonkinensis* have emerged as a versatile class of bioactive compounds with significant therapeutic potential. Their extraction typically employs organic solvents such as methanol or ethanol, followed by chromatographic techniques for isolation and purification. Advanced analytical methods, including high-performance liquid chromatography and nuclear magnetic resonance spectroscopy, are crucial for elucidating their molecular structures. These diterpenoids exhibit notable biological activities across diverse therapeutic areas. As anticancer agents, they demonstrate potent efficacy in both monotherapy and combination therapies with radio- or chemotherapy, modulating key apoptotic and signaling pathways across various cancer types. Additionally, their strong anti-inflammatory properties, mediated by the regulation of nitric oxide production, oxidative stress, and NF-κB activation, underscore their potential in managing inflammatory diseases. With low IC_{50} values and high efficacy in cell-based assays, these compounds also represent promising candidates for antimycobacterial therapies, particularly against drug-resistant tuberculosis. Furthermore, their osteogenic properties are evident in their ability to significantly enhance alkaline phosphatase (ALP) activity, upregulate osteoblastic gene promoter activity, and, in some cases, increase mRNA levels of ALP and collagen type I alpha, thus promoting osteoblast differentiation and bone matrix production. These findings highlight the therapeutic versatility of ent-kaurane diterpenoids, warranting further in vivo investigations to advance their clinical applications.

Conclusion: Ent-kaurane diterpenoids from *Croton tonkinensis* exhibit multifaceted biological activities, including anticancer, anti-inflammatory, antitubercular, and osteogenic effects. These findings highlight their potential as lead compounds for novel therapeutic agents.

Keywords: *Croton tonkinensis, ent-kaurane diterpenoids, anticancer, anti-inflammation, antibaterial effect.*

I. INTRODUCTION

Croton tonkinensis, a tropical shrub indigenous to Northern Vietnam locally known as 'kho sam cho la', has been extensively utilized in traditional Vietnamese medicine. It is employed in the treatment of various ailments, including abscesses, impetigo, and gastrointestinal conditions such as gastric, duodenal ulcers and stomachaches [1-2]. Additionally, it has been applied therapeutically for managing malaria, urticaria, leprosy, psoriasis, and genital prolapse. These diverse medicinal applications highlight its significance in traditional healthcare systems [1].

Building upon the extensive history of *C. tonkinensis* in traditional medicine, modern analytical techniques have been employed to identify and isolate bioactive compounds for

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potential therapeutic applications. As a member of the *Euphorbiaceae* family, the plant is notable for its abundance of diterpenoids, particularly ent-kaurane diterpenoids. These compounds are distinguished by their complex ring structures and functional groups, making them suitable for pharmacological targeting. This review examines the recent findings on the biological effects of ent-kaurane diterpenoids extracted from *C. tonkinensis*, focusing on anticancer, anti-inflammatory, antimicrobial, and osteogenic properties.

II. OVERVIEW OF ENT-KAURANE DITERPENOIDS EXTRACTED FROM *C. TONKINENSIS*

2.1. Extraction and structural characterization

Extraction methods for ent-kaurane diterpenoids often employ organic solvents (e.g., methanol, ethanol) combined with chromatographic techniques for isolation

and purification. Advanced methods, including high-performance liquid chromatography (HPLC) and nuclear magnetic resonance (NMR) spectroscopy, are critical for elucidating the molecular structures of these diterpenoids.

Extraction techniques

The extraction and purification of bioactive compounds from *Croton tonkinensis* involve similar methodologies across various studies, employing solvent-based extractions, partitioning, and chromatographic techniques to isolate target compounds of diterpenoids. Initially, methanol (MeOH) or ethanol (EtOH) was universally employed as the primary extraction solvent due to their effectiveness in solubilizing a wide range of bioactive constituents. The resulting extracts were concentrated under reduced pressure to obtain crude materials for further processing. Fractionation followed, utilizing solvents of increasing polarity or the mixture of them, such as n-hexane, dichloromethane (CH_2Cl_2), ethyl acetate (EtOAc), and n-butanol (n-BuOH), to separate hydrophobic and hydrophilic components, with the n-hexane and CH_2Cl_2 fractions often demonstrating significant bioactivity. Chromatographic purification was achieved through silica gel chromatography with gradient elution systems (e.g., n-hexane-EtOAc) for initial separation, complemented by preparative high-performance liquid chromatography (HPLC) for final purification of target compounds. Across this method, the primary focus was the isolation of ent-kaurane diterpenoids, which were consistently obtained in milligram quantities, underscoring their pharmacological relevance [3-7].

Structural attributes

The ent-kaurane diterpenoids have a characteristic four-ring core structure. Variations in functional groups across these rings lead to diverse biological activities. Specific modifications, such as hydroxylation and oxidation states, have been shown to enhance bioactivity [3-7]. Among the key compounds, CrT1 (ent-18-acetoxy-7β-hydroxy kaur-15-oxo-16-ene) and other ent-kaurane diterpenoids with a 15-oxo-16-ene moiety have been shown to possess significant cytotoxic activity on various cancer cell lines [7-8].

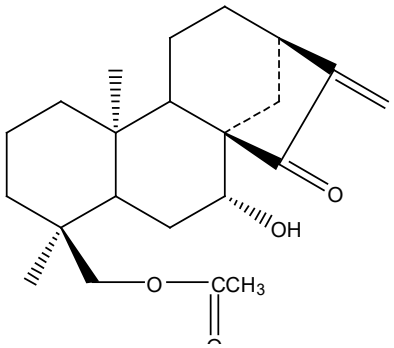

Figure 1. **Structure of *ent*-18-acetoxy-7*β*-hydroxy kaur-15-oxo-16-ene (CrT1) [8]**

2.2. Anticancer properties

Ent-kaurane diterpenoids derived from *Croton tonkinensis*, have garnered attention for their promising anticancer properties. These compounds have shown broad anticancer activity across multiple cancer types, including hepatocellular carcinoma (HCC), colorectal cancer, breast cancer, ovarian cancer, and head and neck squamous cell carcinoma (HNSCC), highlighting their potential as therapeutic agents. The molecular mechanisms underlying the anticancer effects of ent-kaurane diterpenoids include apoptosis induction, reactive oxygen species (ROS) generation, and modulation of critical signaling pathways, such as AMPK, JNK, and ERK1/2.

The anticancer efficacy of ent-kaurane diterpenoids has been extensively tested in various cancer cell lines, including HepG2 and Hep3b for HCC, Caco-2 and LS180 for colorectal cancer [9-11], MCF-7 and MDA-MB-231 for breast cancer [10], SKOV3 for ovarian cancer [12], and OML1 and OML1-R for HNSCC [13]. Among the key compounds, CrT1 (ent-18-acetoxy-7β-hydroxy

kaur-15-oxo-16-ene) and other ent-kaurane diterpenoids with a 15-oxo-16-ene moiety have been shown to possess significant cytotoxic activity, with inhibitory concentrations (IC_{50}) ranging from sub-micromolar to micromolar levels [11,15].

The mechanisms by which ent-kaurane diterpenoids exert their anticancer effects are diverse. A key mechanism involves the induction of apoptosis, which is facilitated through the activation of caspases (caspase-3, -7, -8, -9) and poly(ADP-ribose) polymerase (PARP), alongside the modulation of apoptotic regulators such as Bax, p53, and Bcl-2 [9,11,14]. In colorectal cancer, ROS generation is critical for activating JNK through MKK4 phosphorylation, ultimately leading to apoptosis [10]. Additionally, the activation of AMP-activated protein kinase (AMPK) has been linked to the anticancer effects of CrT1, where it modulates the mTOR/p70S6K pathway, driving tumor suppression and apoptosis in HCC cells. Moreover, CrT1's cytotoxicity is accompanied by the inhibition of tumor growth *in vivo*, offering potential as a chemotherapeutic agent [10]. Furthermore, in HNSCC, ent-kaurane diterpenoids inhibit the PI3K/AKT/mTOR pathway, enhancing radio-sensitization and reducing cell viability [15]. The activation of ERK1/2, particularly in ovarian cancer, is also a crucial pathway through which these compounds exert their effects, inducing apoptosis and inhibiting migration and invasion [14].

Moreover, ent-kaurane diterpenoids exhibit synergistic effects when combined with other therapies. In HCC, subtoxic concentrations of these compounds have been shown to sensitize cells to doxorubicin, enhancing apoptosis [8]. In HNSCC, these diterpenoids potentiate the effects of radiotherapy by inhibiting key survival pathways, demonstrating their potential as radiosensitizers [15].

These studies collectively emphasize the anticancer efficacy of *Croton tonkinensis*, particularly its ent-kaurane diterpenoids. The findings support further exploration of these compounds as promising leads for developing novel anticancer agents, with a focus on their structure-activity relationships and effectiveness against drug-resistant cancer types. Future studies should focus on elucidating additional molecular targets, optimizing the pharmacokinetics and bioavailability of these compounds, and conducting clinical trials to assess their safety and efficacy in humans. Combining ent-kaurane diterpenoids with other chemotherapeutic agents or targeted therapies could provide a powerful strategy for cancer treatment.

The anticancer effects of **ent-kaurane diterpenoids** derived from *Croton tonkinensis is summarized in following table*

***Table 1. The anticancer effects of* ent-kaurane diterpenoids *derived from* Croton tonkinensis**

Aspect	Details
Key compound	CrT1 (ent-18-acetoxy-7β-hydroxy kaur-15-oxo-16-ene) and others with 15-oxo-16-ene moiety
Cancer types	HCC (HepG2, Hep3b), Colorectal (Caco-2, LS180), Breast (MCF-7, MDA-MB-231), Ovarian (SKOV3), HNSCC (OML1, OML1-R)
IC50	Sub-micromolar to micromolar levels [11,15]
Molecular mechanisms	**- Apoptosis Induction**: Caspase activation (-3, -7, -8, -9) and PARP cleavage [9,11,14] **- ROS Generation**: JNK activation via MKK4 phosphorylation (colorectal cancer) [10] **- AMPK Activation**: Modulates mTOR/p70S6K pathway (HCC) [10] - **PI3K/AKT/mTOR Pathway Inhibition**: Enhances radio-sensitivity (HNSCC) [15] - **ERK1/2 Activation**: Induces apoptosis, inhibits migration/ invasion (ovarian cancer) [14]
Synergistic effects	- Sensitizes HCC cells to doxorubicin, enhancing apoptosis [8] - Potentiates radiotherapy effects in HNSCC [15]

2.3. Anti-inflammatory activity

Ent-kaurane diterpenoids, isolated from *Croton tonkinensis*, have shown significant anti-inflammatory properties, which make them potential candidates for the treatment of various inflammatory diseases. Their bioactive effects

have been studied in several experimental models, particularly focusing on nitric oxide (NO) production, superoxide anion generation, and the modulation of the NF-kappaB signaling pathway.

A range of ent-kaurane diterpenoids have been evaluated for their anti-inflammatory activities, have demonstrated potent inhibition of LPS-induced NO production, a critical inflammatory mediator. This inhibition was shown to occur at low IC_{50} values of less than 5 μM for several compounds [14]. This suggests that these diterpenoids may serve as effective anti-inflammatory agents by suppressing NO production, which is often upregulated during inflammatory responses.

Additionally, ent-18-acetoxykaur-16-en-15-one displayed strong inhibition of superoxide anion generation and elastase release, both of which are key contributors to the inflammatory response. These effects were noted to be concentration-dependent, with significant suppression of oxidative stress and inflammation markers in the tested cell models [16]. The ability of ent-kaurane diterpenoids to modulate oxidative stress highlights their dual role in reducing both the inflammatory mediator levels and the cellular damage caused by oxidative species.

The molecular mechanisms underlying the anti-inflammatory effects of these diterpenoids have been further elucidated in studies targeting the NF-kappaB signaling pathway. NF-kappaB is a critical regulator of inflammation and immune responses. In a study of four specific ent-kaurane compounds, including both known and newly isolated diterpenoids, it was found that they inhibited LPS-induced NF-kappaB activation in murine macrophage RAW264.7 cells with IC_{50} values ranging from 0.07 to 0.42 μM [17]. This inhibition correlated with reduced production of pro-inflammatory cytokines and NO, indicating that these compounds interfere with the early stages of the inflammatory cascade.

These findings underscore the potential of ent-kaurane diterpenoids as modulators of inflammatory pathways. Their ability to target key molecular players, such as NF-kappaB and reactive oxygen species (ROS), positions them as promising candidates for the development of novel anti-inflammatory drugs. However, despite their potent in vitro effects, further research is required to fully understand the pharmacological profiles of these compounds in vivo. Specifically, studies investigating their bioavailability, toxicity, and long-term effects in animal models will be critical to advancing their clinical applications. Moreover, the synergistic effects of these compounds with existing anti-inflammatory drugs should be explored to enhance therapeutic efficacy in treating chronic inflammatory diseases.

2.4. Antibacterial activity

Recent studies have highlighted the significant antibacterial properties of ent-kaurane diterpenoids, particularly against *Mycobacterium tuberculosis* (M. tuberculosis), the causative agent of tuberculosis (TB). These diterpenoids, which are rich in bioactive functional groups, exhibit potent activity against both drug-susceptible and drug-resistant strains of M. tuberculosis, marking a noteworthy contribution to the search for novel antituberculosis agents.

Among the various diterpenoids tested, ent-1β,7α,14β-triacetoxykaur-16-en-15-one (cpp604) demonstrated the highest antituberculosis activity, with minimum inhibitory concentrations (MIC) of 0.78 μg/ml, 1.56 μg/ml, and 3.12-12.5 μg/ml against the H37Ra, H37Rv, and several resistant strains of M. tuberculosis, respectively. These results indicate that cpp604 possesses broad-spectrum activity against both sensitive and resistant strains, which is a critical challenge in the treatment of TB [17]. The antibacterial activity of these diterpenoids is likely linked to the structural features of their molecular scaffolds. The mechanism of action behind the antibacterial effects of ent-kaurane diterpenoids is not yet fully elucidated but is believed to involve disruption of the mycobacterial cell wall or interference with essential metabolic pathways. Their potency against both susceptible and resistant strains indicates that they may target bacterial systems that are less prone to the resistance mechanisms typically encountered with conventional antibiotics, such as rifampicin and isoniazid [18].

Given the rise of multidrug-resistant (MDR) and extensively drug-resistant (XDR) strains of M. tuberculosis, the discovery of novel agents with distinct mechanisms of action is urgently needed. The ent-kaurane diterpenoids from *Croton tonkinensis* show great promise in this regard. However, further research is necessary to explore their full pharmacological profiles, including their bioavailability, toxicity, and the specific molecular

targets they affect within the bacterial cell. In vivo studies will be essential to evaluate the therapeutic potential of these compounds in animal models, and clinical trials will be required to establish their safety and efficacy in humans.

In conclusion, ent-kaurane diterpenoids from *Croton tonkinensis* represent a promising class of compounds for the development of new antimycobacterial agents, particularly in the context of drug-resistant tuberculosis. Their potent activity, coupled with their structural diversity, offers valuable insights into the design of novel antibiotics that could address the growing global threat of tuberculosis. Further investigations into their molecular mechanisms, SAR optimization, and preclinical studies are crucial steps in advancing these compounds from laboratory research to clinical application.

2.4. Osteogenic Activity

One of the intriguing aspects of ent-kaurane diterpenoids is their ability to promote osteoblast differentiation, a critical process in bone formation. A study indicates the osteogenic activity of ent-kaurane diterpenoids isolated from *Croton tonkinensis* and their potential as therapeutic agents for bone diseases such as osteoporosis. Four compounds were assessed using C2C12 cells, a model known for studying osteoblast differentiation. These compounds significantly enhanced alkaline phosphatase (ALP) activity, a key marker of osteoblast function, and upregulated osteoblastic gene promoter activity. Among them, three compounds further increased the mRNA levels of ALP and collagen type I alpha, indicating their role in osteoblast differentiation at the molecular level. These findings suggest that the diterpenoids act by directly stimulating the molecular pathways involved in bone matrix production. Future studies should focus on elucidating the precise molecular targets, exploring the signaling pathways involved, and conducting in vivo assessments to confirm their therapeutic potential and safety for clinical use in treating bone-related disorders [19].

III. CONCLUSION AND FUTURE DIRECTIONS

In summary, ent-kaurane diterpenoids extracted from *Croton tonkinensis* exhibit a range of pharmacological activities, from anticancer, anti-inflammatory and antibacterial effects to promoting bone health. These properties make them a valuable focus for drug development and integrative medicine. Despite promising findings, several gaps remain. For instance, the bioavailability and potential toxicity of ent-kaurane diterpenoids in humans require further exploration. Additionally, understanding the specific molecular mechanisms of action, particularly in multi-target pathways, will be essential for developing effective therapeutic agents based on these compounds.

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SURVEY OF NECK RANGE OF MOTION USING SYSTEM WITH SENSOR-INTEGRATED BASED ON PHOTOMETRY METHOD AND ZERO METHOD ON HEALTHY VOLUNTEERS

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ABSTRACT

Objective: The study aimed to evaluate the accuracy and reliability and of the system with sensor-integrated based on photometry method (PMD-HAM system) compared with the Zero method using a goniometry when measuring the range of motion of the neck joints of healthy volunteers at the Ho Chi Minh City Hospital for Rehabilitation and Occupational Diseases.

Method: Conducted over four months at the Hospital for Rehabilitation – Occupational Diseases, the research included 50 healthy volunteers (24 males, 26 females) with strict inclusion and exclusion criteria. Both conventional goniometry and the system with sensor-integrated based on photometry method were utilized to assess cervical range of motion (ROM) across six movements: flexion, extension, right lateral flexion, left lateral flexion, right rotation, and left rotation.

Results: Results indicated no statistically significant differences between the measurements obtained using both methods ($p > 0.05$). These findings suggest that the system with sensor-integrated based on photometry method is a reliable and valid alternative to traditional measurement techniques for assessing cervical ROM.

Conclusion: The implementation of this innovative method may enhance routine clinical assessments, promote accurate data collection in diverse settings. Future research will involve a more varied participant demographic and refined measurement apparatus to further validate the method's efficacy.

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❖ *These authors have contributed equally to this work and share first authorship.*

Keywords: *Cervical range of motion, photogrammetry, goniometry, the system with sensor-integrated based on photometry method, PMD-HAM system, healthy volunteeers.*

I. INTRODUCTION

Cervical radiculopathy (CR) is a group of clinical symptoms associated with cervical spine pathologies that are accompanied by dysfunction of the cervical roots, spinal nerves and/or cervical spine. Common symptoms include pain in the neck, shoulder, and arm, accompanied by some sensory disorders and/or reduced range of motion in the cervical area. CR with cervical pain, shoulder pain in the population commonly has complications of disability and loss of working ability, especially patients in low-income countries. This is an economic and medical burden for the entire world in general, individual patients and families, communities, and medical forces [1].

The range of motion method (ROM) has been proved to be able to classify initially patients at risk of injury after sudden trauma [2]. In Vietnam, the diagnosis and evaluation of the effectiveness of the treatment is ROM manual method (traditional goniometer). Although the availability has been proved, these instruments require the assistance of skilled operators therefore, the device is cumbersome and requires manual reading.

Photogrammetry is another noninvasive technique and has been widely applied to in cervical measurement [3–6]. However, the preparatory work of photogrammetry is relatively tedious due to the placement of cameras and body markers. Considering the advantages of the photogrammetry we developed an innovative technique for the measurement of Cervical ROM based on it. This approach is reliable, automatic and convenient for people with or without relevant medical knowledge. As a result, this study is intended to evaluate the accuracy and reliability of this new technique for measuring cervical ROM compared to traditional goniometry.

Objective:

1. Compare the results of measuring the range of neck motion (flexion - extension, right lateral flexion - left lateral flexion, right rotation - left rotation) using a body ROM measuring device.

2. Compare the results of measuring the range of neck motion (flexion - extension, right lateral flexion - left lateral flexion, right rotation - left rotation) between researcher 1 and researcher 2 using the body ROM measuring device.

II. SUBJECTS AND METHODS

2.1. Subjects, location and duration

- Duration: April 2024 to August 2024.

- Location: Hospital for Rehabilitation - Professional Diseases, 313 Au Duong Lan street, Ward 2, District 8, Ho Chi Minh City.

- Subject:

Inclusion criteria

+ Participants must be at least 18 years old, regardless of gender or occupation.

+ People who study, work and normal activities.

+ Participants voluntarily agree to participate in the study.

Exclusion criteria

+ Study participants reported or complained of neck, shoulder and/or headache pain in 30 days before.

+ People with a history of neck and/or shoulder disorders, including injuries and fractures, a history of neurological and/or rheumatic disorders.

Healthy volunteer criteria:

Age: 18 years or older

No significant medical history: Free from any chronic or acute illnesses, including but not limited to:Cardiovascular diseases (e.g., heart failure, coronary artery disease);Respiratory diseases (e.g., asthma, COPD);Neurological disorders (e.g., epilepsy, multiple sclerosis);Endocrine disorders (e.g., diabetes, uncontrolled thyroid disease);Autoimmune diseases (e.g., rheumatoid arthritis, lupus);Cancer;Mental health disorders (e.g., severe depression, schizophrenia);Infectious diseases (e.g., HIV, hepatitis);Kidney or liver diseases

2.2. Methods

Research design

Cross-sectional study

Sample size

A prior sample size calculation is based on the methods of Walter et al. [7], assuming significance level (α) = 0.05, type II error probability (β) = 0.2, confidence level Minimum acceptable reliability (ρ0) = 0.7 and expected reliability (ρ1) = 0.9, and n = 2; Anticipating a 10% sample loss, a sample size of 50 participants would be required.

p0	p1								
	0·1	0·2	0·3	0·4	0·5	0·6	0·7	0·8	0·9
n = 2									
0	651·6	151·9	70·0	35·9	22·0	14·4	9·7	6·6	4·4
0·1		591·2	142·8	60·6	32·2	19·1	12·0	7·7	4·8
0·2			543·7	128·2	53·0	27·2	15·5	9·2	5·3
0·3				476·2	109·0	43·5	21·4	11·4	6·1
0·4					393·1	86·6	32·9	15·1	7·1
0·5						300·3	62·6	22·0	8·8
0·6							205·4	39·1	11·7
0·7								117·1	18·4
0·8									45·8

Variables

- Background variables:

+ Age: year of study minus year of birth;

+ Gender: Male/Female.

- Research variables:

Range of motion (ROM)	Quantitative variable	**Attaching a coordinate system Oxyz to** The origin O is at the midpoint of the spinous process of the C7 vertebra. Ox: right-left axis Oy: bottom-top axis Oz: back-front axis **Identify the points to be measured:** C: Vertex of the head (point of intersection between two lines: one line passing horizontally through the top of the ear and one line passing vertically through the center of the head). E: Vertex of the nose. **Convention for the measured variables** **Researcher measures** ROM for flexion-extension (View from the side): EOy when bending forward and backward. ROM for lateral bending (View from behind): COy when bending left and right. ROM for rotation (View from above): EOz when rotating left and right. **Measuring device** ROM for flexion-extension (View from the side - Oyz plane): EOy when bending forward and backward. ROM for lateral bending (View from behind - Oxy plane): COy when bending left and right. ROM for rotation (View from above - Oxz plane): EOz when rotating left and right.

Measurement and data collection tools

- A goniometer used for measuring of joint range of motion has calibration certificate No. KT3-00481ADD4 on April 11, 2024.

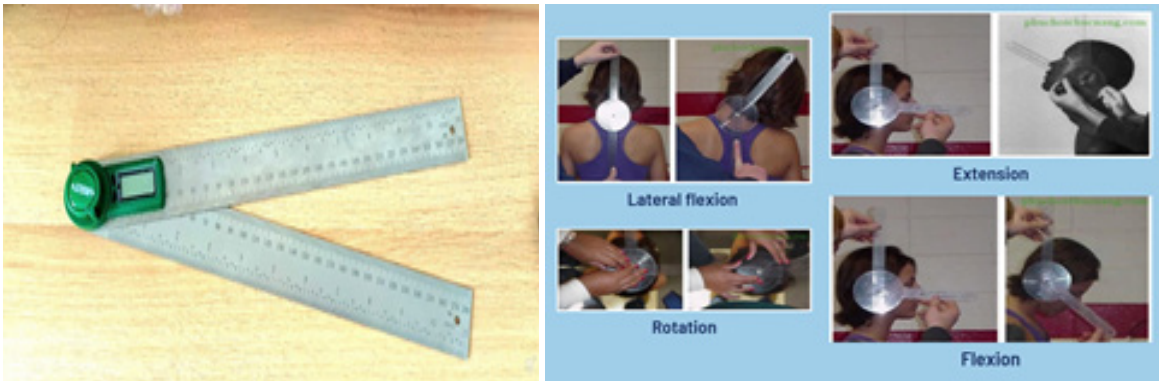


Figure 1. Goniometer

- ROMIX photogrammetric instrument has been standardized at the Ho Chi Minh City Quality Measurement Standards Technical Center under No. 0832TN22/TĐC – TN on October 28, 2023.

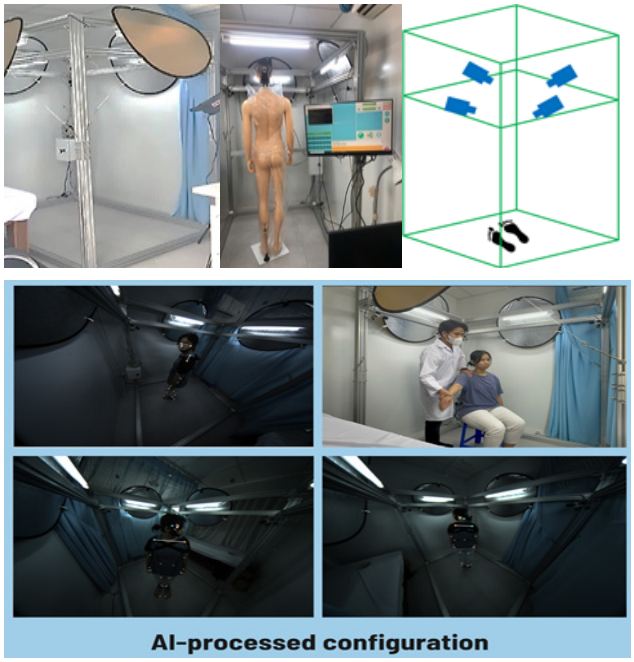


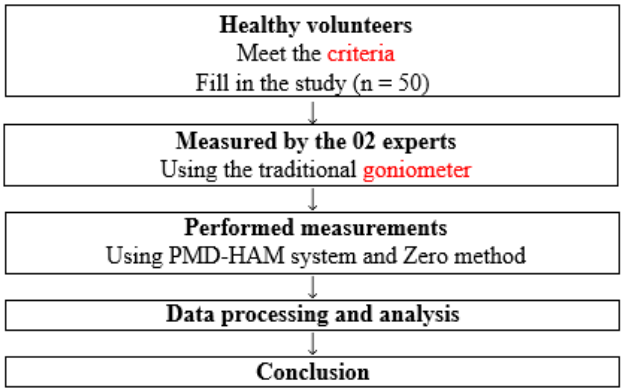
Figure 2. PMD- HAM systems

Photometric Machine

The participants' cervical ROM were measured using the photometric machine.

All images from the machine and the results from the researchers were transferred to a computer for analysis.

Procedure



Statistical methods – data processing

Data collected was processed according to medical statistical algorithms of SPSS 25 software. Compare average ± standard deviation by using one-way ANOVA test.

2.3. Research ethics

- Research is only to evaluate and improve volunteers' health, not for any other purpose. Research participants volunteered to participate after the research process was clearly explained.

- Monitor and evaluate the condition of study participants after 1 month. If the volunteer develops any unpleasant health symptoms caused by the research methods of this study, the researcher will be responsible for consultation and treatment.

- When research participants show signs of not cooperating further or request to stop participating in the research, the research will be stopped.

- Evaluation of research participants' results is done objectively and honestly in data processing.

III. RESULTS

The mean of all six cervical movements from researcher 1, researcher 2 and the photogrammetry are depicted in Table 1. The results of measuring the Cervical ROM of all six cervical movements between researcher 1, researcher 2 and the Photogrammetry machine do not change statistically significantly ($p > 0.05$) (Table 2).

Table 1. Cervical range of motion from researcher 1 and PMD-HAM system

		Researcher 1			PMD-HAM system		
		Range (°)	Mean (°)	Standard deviation (°)	Range (°)	Mean (°)	Standard deviation (°)
Flexion	Male	34-60	45.7	6.88	32-58	44.99	6.07
	Female	32-71	48.24	10.45	34-72	48.19	10.12
Extension	Male	31-43	35.76	4.03	29-43	34.32	4.46
	Female	29-49	37.74	6.01	31-48	38.13	5.27
Right lateral flexion	Male	31-53	42.18	4.94	36-54	43.04	4.49
	Female	34-50	42.06	5.03	32-55	44.11	5.23

		Researcher 1			PMD-HAM system		
		Range (°)	Mean (°)	Standard deviation (°)	Range (°)	Mean (°)	Standard deviation (°)
Left lateral flexion	Male	32-52	40.07	4.57	30-52	40,37	4.62
	Female	34-53	43.23	5.74	33-53	42.62	5.04
Right rotation	Male	55-84	74.02	6.18	56-85	74.16	6.44
	Female	65-83	75.71	5.27	65-85	77.95	5.86
Left rotation	Male	55-86	71.15	6.82	55-83	71.60	6.84
	Female	63-84	72.71	5.16	64-84	74.98	5.45

Table 2. Cervical range of motion from researcher 2 and PMD-HAM system

		Researcher 2			PMD-HAM system		
		Range (°)	Mean (°)	Standard deviation (°)	Range (°)	Mean (°)	Standard deviation (°)
Flexion	Male	33-60	45.86	7.02	32-58	44.99	6.07
	Female	34-72	47.04	9.67	34-72	48.19	10.12
Extension	Male	30-44	35.1	3.92	29-43	34.32	4.46
	Female	30-50	38.01	5.98	31-48	38.13	5.27
Right lateral flexion	Male	33-54	41.87	5.07	36-54	43.04	4.49
	Female	33-52	43.19	5.24	32-55	44.11	5.23
Left lateral flexion	Male	30-49	40.12	4.19	30-52	40.37	4.62
	Female	33-53	43.24	5.13	33-53	42.62	5.04
Right rotation	Male	57-89	74.27	6.24	56-85	74.16	6.44
	Female	63-91	74.37	6.98	65-85	77.95	5.86
Left rotation	Male	53-86	70.25	7.30	55-83	71.60	6.84
	Female	64-87	75.43	5.32	64-84	74.98	5.45

Table 3. Comparison of CROM between two researchers using One-Way Anova

Position	Researcher	p
Flexion	Researcher 1	0.782
	Researcher 2	
Extension	Researcher 1	0.795
	Researcher 2	
Right lateral flexion	Researcher 1	0.783
	Researcher 2	
Left lateral flexion	Researcher 1	0.715
	Researcher 2	
Right rotation	Researcher 1	0.687
	Researcher 2	
Left rotation	Researcher 1	0.822
	Researcher 2	

Table 4. Comparison of flexion and extension from PMD-HAM system using One-Way Anova

Position	CROM		p
Flexion	Time 1	Time 2	0.776
		Time 3	0.812
	Time 2	Time 3	0.795

Position	CROM		p
Extension	Time 1	Time 2	0.787
		Time 3	0.654
	Time 2	Time 3	0.834

Table 5. Comparison of right, left lateral flexion from PMD-HAM system using One-Way Anova

Position	CROM		p
Right lateral flexion	Time 1	Time 2	0.823
		Time 3	0.706
	Time 2	Time 3	0.845
Left lateral flexion	Time 1	Time 2	0.876
		Time 3	0.687
	Time 2	Time 3	0.833

Table 6. Comparison of right and left rotation from PMD-HAM system using One-Way Anova

Position	CROM		p
Right rotation	Time 1	Time 2	0.745
		Time 3	0.587
	Time 2	Time 3	0.712
Left rotation	Time 1	Time 2	0.734
		Time 3	0.507
	Time 2	Time 3	0.737

IV. DISCUSSION

Our research was carried out on 50 healthy vonlunteers consisting of 24 males and 26 females, who were assessed the ROM on the six neck movements. ROM of neck flexion and extension measured by the two researchers and the machine are compatible to those in the research of Green and Heckman 1994 [7], which is 45° in flexion and 38° in extension. ROM of neck lateral flexion measured by the two researchers and the machine are compatible to those in the research of American Medical Association 1998 [9], which is 45° in the right and 38° in the left side. ROM of neck rotation measured by the two researchers and the machine are compatible to those in the research of Green and Heckman 1994 [7], which is 45° on both sides. We can see that in researches with different sample sizes, volunteers' statistics and geography, the ROM may vary between ages and sexes. Therefore, tools and equipment used in the research play an important role. The Zero method we use in the research has been approved by the American Plastic Surgery Conference and the Vancouver Conference in 1964 [11] since 1964 and the traditional goniometer in Ho Huu Luong's research [12], which have been standardized and highly reliable.

This study developed a novel photogrammetric method for the measurement of 3D ROM. The mean of range of this method was investigated by comparing it with the goniometer- based method. The One way – Anova analysis showed there was no significant difference between ($p > 0.05$) the new method and the goniometer based method for all six cervical movements. Besides, our method is relatively affordable for routine examinations. As for the traditional measurement tools like the goniometer, using these tools requires the assistance of an operator with relevant medical knowledge, and the operation of measuring and data reading is completely manual, which may introduce random error. Our method, on the contrary, can record and analyze the Cervical ROM regardless of the position and posture of the neck in 3D space, and the whole procedure is done automatically by program, which is more correct and reliable. In addition, our team is applying a

sensor device that applies the Euler angle principle to the measurement method to further standardize the measuring machine, with the goal of optimizing the process of measuring the range of motion of the neck joint, applied in collecting biometric data as well as helping in the clinical practice of neck diseases.

V. CONCLUSION

The performance of the proposed photogrammetric method for the measurement of 3D CROM was deeply analyzed by comparison with other approaches, and results showed excellent consistency and reliability. This shows that the measurements, when repeated, are not biased parameters, and at the same time reliable when the operator performs operations according to standardized measurement procedures. Based on this technique, a Cervical ROM historical database could be set up to better check the changes of Cervical ROM. In the future work, a more diverse group of subjects including healthy and unhealthy people will be involved, and a more precise device will be used as a synchronous reference of the proposed method. In-depth research will also be conducted on pattern analysis of cervical motion curves, to consider its relevant wellness management applications in clinical and home applications.

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KNOWLEDGE OF SAFE INJECTION PRACTICES, PREVENTION OF SHARP INJURIES, AND MEDICAL WASTE MANAGEMENT IN NURSING STUDENTS OF THE UNIVERSITY OF MEDICINE AND PHARMACY AT HO CHI MINH CITY

Doan Minh Nhut[1*], Hua Nguyen Bao Tran[1]

ABSTRACT

Objective: To describe the knowledge regarding safe injection practices, prevention of sharp injuries and medical waste management in Nursing students of the University of Medicine and Pharmacy at Ho Chi Minh City.

Method: A cross-sectional study conducted in 264 Nursing students, during the academic year 2022-2023. A pre-designed questionnaire was used to survey knowledge regarding standard precautions.

Results: The study found that 51% of nursing students possessed accurate knowledge regarding safe injection practices and the prevention of injuries from sharp objects. Notably, the aspect concerning contact precautions for managing wounds in HIV/AIDS patients had the highest correct response rate at 92.1%. Additionally, 73% of nursing students demonstrated correct knowledge about medical waste management, with the highest accuracy (93.2%) in the area of waste segregation at the point of generation.

Conclusion: Overall, more than half of the students have correct knowledge about safe injection practices, prevention of sharp injuries, and medical waste management in standard precautions (all above 50%).

Keywords: *safe injection practices, standard precautions, nursing students*

I. INTRODUCTION

Currently, bloodborne infections pose a significant concern in the medical field, particularly for the nursing sector, which is directly involved in procedures that may expose them to blood and body fluids. Non-compliance or poor compliance with standard precautions can make them vulnerable to occupational exposure risks during patient care [1]. Nurses exposed to bloodborne pathogens, bodily fluids, or airborne pathogens are at risk of contracting occupational infections such as HIV/AIDS, hepatitis B, hepatitis C, tuberculosis, and other infectious diseases [2]. Moreover, nursing students frequently participate in clinical practice, putting them at high risk of exposure to infection-causing factors. However, nursing students have less practical experience compared to healthcare professionals. Therefore, providing standard precaution knowledge to nursing students is essential, as it can help achieve outcomes such as reducing nosocomial infection rates, minimizing healthcare risks for both healthcare workers and the students involved in clinical practice [3,4]. Based on this reality, we aim to conduct the study: "Knowledge of Standard Precautions among Nursing Students at the University of Medicine and Pharmacy at Ho Chi Minh City".

II. SUBJECT AND METHODS

2.1. Subjects, locations, and study period

Inclusion Criteria: Nursing students in their third or fourth year at the University of Medicine and Pharmacy, Ho Chi Minh City, who agree to participate in the study.

Exclusion Criteria: Students who have deferred their studies or those who did not fully complete the survey questionnaire.

Time and location

Time Period: From August 2022 to June 2023.

Location: Faculty of Nursing and Medical Technology, University of Medicine and Pharmacy at Ho Chi Minh City.

2.2. Method

Study Design: a cross-sectional descriptive study

Sample Size: the sample size was calculated using the formula

$$n \geq \frac{Z^2_{1-\alpha/2}(1-p)p}{d^2}$$

α: significance level (α = 0.05)

Z: standard normal distribution value at 95% confidence level

P: estimated proportion, p = 0.787 (According to the findings of Vo Van Tan et al regarding

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the percentage of nursing students possessing knowledge of standard prevention measures [5]

d: maximum allowable error of the estimate (d = 0.05)

Substituting these values into the formula, the calculated sample size is n = 264.

Sampling Method: stratified random sampling method was applied based on the academic years (third and fourth year) of the students. The number of samples required from each stratum (class) was calculated using the formula**:**

$$ni = \frac{nNi}{N}$$

n is the sample size in the study

ni is the total number of samples needed from each class

Ni is the current number of students in each class

N is the total number of students in the 2019-2023 and 2020-2024 cohorts of the Nursing program. The number of students included in the sample is:140 third-year students and 124 fourth-year students

2.3. Data Collection Tool

The data collection tool is a standardized prevention knowledge questionnaire for students by author Lê Thị Nga (2016) in the study "Knowledge and Attitudes about Standard Preventive Measures of Students at Hanoi Medical University." The questionnaire was evaluated for reliability with a Cronbach's alpha of 0.88. The content of the questionnaire includes 71 questions divided into 10 sections (one section on students' personal information and nine sections on standard preventive measures). Each correct answer is awarded 1 point, and incorrect answers receive 0 points. Students' knowledge is considered adequate if they correctly answer more than 70% of the total questions on standard preventive measures [6]. The overall accuracy rate for each section is determined by calculating the mean correct answer rate across all questions within that section.

Data Processing and Analysis: Data entry was performed using Epidata Entry Client software. Data analysis was conducted using STATA 17.0 software. Frequencies and percentages were used to describe qualitative variables.

Ethical issues: The study was approved by the Ethics Committee in Biomedical Research at the University of Medicine and Pharmacy at Ho Chi Minh City, under the approval number 1055/HĐĐĐ-ĐHYD dated December 9, 2022.

Funding: The study was conducted with financial support from the University of Medicine and Pharmacy at Ho Chi Minh City.

III. RESULTS

Table 1. Individual characteristics of students

Factors		Quantity	Ratio (%)
Gender	Male	29	10.98
	Female	235	89.02
Academic year	Third-year students	140	53.03
	Fourth-year students	124	46.97

Research Results: The study results show that among the total number of nursing students participating in the research, the number of fourth-year students was 1.74 times higher than the number of third-year students (63.26% compared to 36.74%). Additionally, the findings indicated that the majority of students participating in the study were female (89.02%), a figure 8.1 times higher than that of male participants.

Table 2. Knowledge about safe injection practices and prevention of injuries from sharp objects

Contents	Correct Answer	
	Quantity	Ratio (%)
Injuries from sharp objects should be self-treated and do not need to be reported (False)	239	90.5
Used syringes should be bent to avoid injury (False)	230	87.1
Dirty sharp objects should be crushed before disposal (True).	94	35.6
Used syringes should be recapped to avoid injury (False)	100	37.9
Needlestick injuries are the most common in clinical settings (False).	33	12.5
Exposure prophylaxis is used to manage wounds in patients with HIV/AIDS (True)	243	92.1

The results in the table above show that the knowledge of students participating in the study about safe injection practices and prevention of injuries from sharp objects is uneven. The content with the highest correct response rate is the use of exposure prophylaxis to manage wounds in patients with HIV/AIDS (92.1%). Additionally, most students also correctly answered the question about reporting after being injured by sharp objects (90.5%). However, the correct response rates for handling dirty sharp objects and not recapping used syringes were much lower, at 37.9% and 35.6%, respectively.

Table 3. Knowledge about medical waste management

Contents	Correct answer	
	Quantity	Ratio (%)
Waste must be sorted at the source of generation (True).	246	93.2
Waste storage areas must be at least 1000 meters away from dining areas, patient rooms, public walkways, and crowded areas (False).	39	14.7
Hazardous medical waste and general waste must be stored separately (True).	244	92.4
Initial treatment of highly infectious waste: by chemicals or moist heat (True).	229	86.7
Disposal of general waste: landfill or recycling (True).	200	75.8

The results in the table show that for the two contents of sorting waste at the source of generation and separately storing hazardous medical waste and general waste, the percentage of students who answered correctly was the highest and nearly equal at 93.2% and 92.4%, respectively. Conversely, only 14.7% of students correctly identified the minimum distance from waste storage areas to dining areas, patient rooms, public walkways, and crowded areas. For the remaining contents on the initial treatment of highly infectious waste and the disposal methods for general waste, the correct response rates were also relatively high (both over 75%)

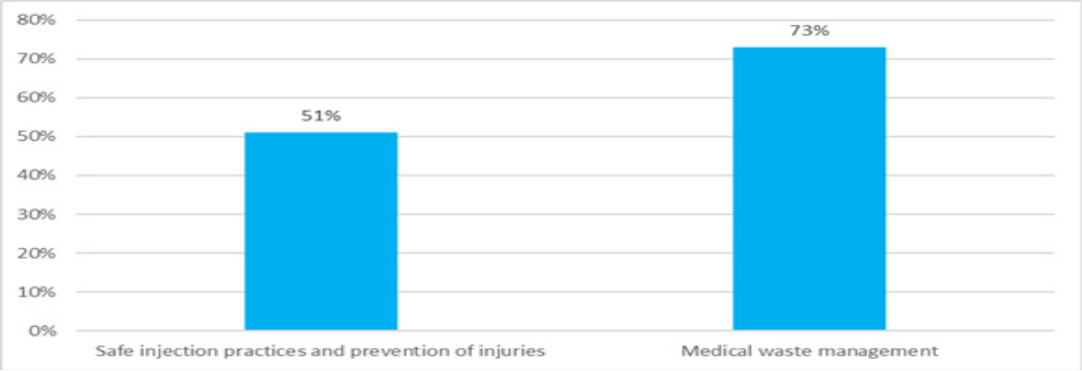

***Figure 1.* Correct response rate for knowledge content of the questions**

Overall, the percentage of students who correctly answered questions about standard preventive knowledge, including safe injection practices, prevention of injuries from sharp objects, and medical waste management, was over 50% of the students participating in the study. Among these, knowledge about medical waste management had a relatively high percentage (73%). The contents on safe injection practices and prevention of injuries from sharp objects had lower correct response rates than the above content but still accounted for more than half of the students participating in the study (over 50%).

IV. CONCLUSION

The research results show that most students correctly answered questions on safe injection practices and prevention of injuries from sharp objects. Aspects such as reporting injuries from sharp objects, not bending used syringes, and using exposure prophylaxis for wounds in patients with HIV/AIDS had the highest correct response rates. These results are significantly higher compared to

the studies by Lê Thị Nga in 2016 and Mn. Huson Amin Ghalya, Prof. Youssreya Ibrahim, with rates of over 60% and over 45%, respectively [6], [7]. Most students answered incorrectly to the question "Needlestick injuries are the most common in clinical settings," resulting in the lowest correct response rate among all six questions (12.5%). Similarly, in the study by Lê Thị Nga in 2016, this question also had the lowest correct response rate (11.9%) [6]. However, in the study by Mn. Huson Amin Ghalya and Prof. Youssreya Ibrahim, this rate reached an impressive 76.0% [7]. Although aware of the dangers of exposure to blood and bodily fluids during their studies and clinical practice, most students are not well-versed in standard preventive techniques. Specifically, their knowledge of safe injection practices and prevention of injuries from sharp objects is not high. This issue should be addressed because administering injections and infusions are common procedures performed by students. If their knowledge of prevention and management of injuries is inadequate, students are at high risk of exposure to sharp objects during injections and infusions, and potentially contracting HBV, HCV, and HIV through these sharp objects [3],[4]. Therefore, it is imperative that students are comprehensively equipped with knowledge in this area prior to transitioning into fully qualified healthcare professionals.

The research results indicate that 73% of nursing students possess accurate knowledge regarding medical waste management. When compared to other studies involving nursing and medical students, this percentage shows a significant difference. In Vietnam, a study conducted at Hanoi Medical College (2016-2017) revealed that the percentage of nursing students with correct knowledge about medical waste classification was 71.6% before intervention and increased to 93.2% after intervention [8]. Meanwhile, a study conducted at Hanoi Medical University in 2021 on medical students revealed that only 45.8% of students correctly answered the definition of medical waste, and 49.2% accurately identified the types of hazardous infectious waste [9].

Globally, a study conducted in India in 2021 revealed that 95.1% of nursing students had poor knowledge regarding medical waste management, despite their attitudes and practices being relatively good [10]. A study conducted in Turkey in 2019 showed that 89.1% of nursing students had received training in medical waste management, yet there were still significant shortcomings in self-protection and the classification of recyclable waste [11]. Compared to studies conducted in Zambia, your rate of 73% is higher, indicating that nursing students in Vietnam have better knowledge of medical waste management [12]. However, compared to developed countries, the management and disposal of medical waste in Vietnam still face many challenges. The research results contribute to clarifying the overall picture of nursing students' knowledge of medical waste management, while also emphasizing the necessity of training and raising awareness among students.

V. CONCLUSION

Overall, more than half of the students possess accurate knowledge regarding safe injection practices, prevention of injuries from sharp objects, and medical waste management in standard precautions (all above 50%). The percentage of students with correct knowledge about safe injection practices and prevention of injuries from sharp objects is 51%. The percentage of students with correct knowledge about medical waste management is 73%.

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CHARACTERISTICS OF HEART PATTERNS ACCORDING TO TRADITIONAL MEDICINE IN PATIENTS WITH CARDIOVASCULAR DISEASE

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ABSTRACT

Objective: To investigate the characteristics of heart patterns according to traditional medicine and to examine the relationship between pro-BNP, EF indices, and the occurrence of these syndromes in patients with cardiovascular disease.

Method: A cross-sectional descriptive study was conducted on 180 patients diagnosed with chronic coronary syndrome and/or chronic heart failure, who were undergoing inpatient treatment at the Cardiology Department of Hue University of Medicine and Pharmacy Hospital.

Results: The syndromes of Heart Qi deficiency, Heart Qi and Blood deficiency, and Heart Qi and Yin deficiency were among the most commonly observed, with a prevalence rate exceeding 80%. In contrast, the syndrome of Upward flaming of heart fire was the least prevalent, occurring at a rate of 1.1%. The moderate level occurred at the highest rate in these three syndromes: Heart Qi deficiency, Deficiency of heart Qi and Blood, and Deficiency of heart Qi and Yin; the average score of the level was also the highest in these three syndromes. Individuals with a Deficiency of heart Qi and Yang pattern exhibited higher pro-BNP levels than those without this syndrome. Conversely, individuals with Water retention affecting the heart pattern showed lower EF levels than those without this syndrome. Individuals with the Heart Yang deficiency pattern had lower pro-BNP levels compared to those without the syndrome. Additionally, individuals with the Disharmony between the heart and kidney pattern and Heart and spleen deficiency pattern demonstrated higher EF levels compared to those without these syndromes ($p < 0.05$).

Conclusion: Heart Qi deficiency, Heart Qi and Blood deficiency, and Heart Qi and Yin deficiency were prevalent patterns with the most significant impact. There were significant differences in pro-BNP and EF levels between individuals with and without the patterns of Deficiency of heart Qi and Yang, Water retention affecting the heart, Heart Yang deficiency, Disharmony between the heart and kidney pattern, and Heart and spleen deficiency.

Keywords: *Chronic coronary syndrome, chronic heart failure, heart organ, traditional medicine*

I. INTRODUCTION

Cardiovascular diseases have been and continue to be a major global health issue, with high mortality rates. According to estimates from the World Health Organization, approximately 17.9 million people die from cardiovascular diseases each year, accounting for 31% of total global deaths. Among cardiovascular diseases, coronary artery disease and heart failure were conditions with high morbidity and mortality rates. Coronary artery disease alone accounts for 14% of global mortality and is a leading cause of reduced life expectancy [1]. Community studies have shown that 30-40% of patients die within one year, and 60-70% die within five years after being diagnosed with heart failure [2]. Therefore, accurate diagnosis and early treatment of coronary artery disease and heart failure were crucial to increase life expectancy and improve the quality of life for patients.

In traditional medicine, cardiovascular diseases were often characterized by pathological manifestations primarily associated with the “heart organ”. The heart organ functions as the principal controller of blood vessels, encompassing two primary aspects: governing blood and governing vessels. These roles contribute to the distribution and circulation of blood within the vascular system. The heart also functions as a continuously contracting organ, propelling blood throughout the entire body, and thereby driving circulatory dynamics. This activity facilitates the systemic distribution and circulation of blood, essential for maintaining bodily functions. Together, the heart, blood vessels, and blood create a unified circulatory system, with the heart serving as the primary driving force within this network [3]. In traditional medicine,

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diagnostic evaluations primarily rely on clinical examinations, with minimal use of ancillary testing. This reliance can result in delayed detection of disease, thereby impacting treatment quality. With the continuous advancements in evidence-based medicine, exploring the relationship between traditional medicine syndromes and highly sensitive and specific laboratory indices was increasingly essential. Such an approach enables more accurate and timely diagnoses, thereby enhancing treatment outcomes. At present, research exploring the theoretical connections between the “heart organ” in traditional medicine and cardiovascular diseases remains limited. Additionally, there was a lack of standardized, objective criteria for classifying and diagnosing symptoms and syndromes within this framework. Based on the above theoretical and practical foundations, we conducted this study with two objectives:

(1) To investigate the characteristics of heart patterns according to traditional medicine in patients with cardiovascular diseases at the Hue University of Medicine and Pharmacy Hospital.

(2) To examine the relationship between pro-BNP, EF indices, and the occurrence of heart organ syndromes in patients with cardiovascular diseases at the Hue University of Medicine and Pharmacy Hospital.

II. SUBJECTS AND METHODS

Research subjects

Patients diagnosed with chronic coronary syndrome (CCS) and/or chronic heart failure (CHF) who were receiving inpatient treatment at the Department of Cardiology, Hue University of Medicine and Pharmacy Hospital.

2.1.1. Inclusion Criteria

- Patients diagnosed with chronic heart failure according to the ESC 2021 guidelines [4].

- Patients diagnosed with chronic coronary syndrome according to the ESC 2019 guidelines [5].

- Patients who agree and voluntarily participate in the study.

Exclusion Criteria

- Patients who were unable to hear, understand, or respond to questions during the examination.

- Patients who were physically debilitated or had signs of mental disorders.

Research Methodology

***Study Design*:** Cross-sectional descriptive study.

Sample Size and Sampling Method: Convenience sampling method: all patients who meet the inclusion criteria during the study period. The total sample size collected was 180 patients.

Study Duration and Location: From August 2023 to April 2024 at the Department of Cardiology, Hue University of Medicine and Pharmacy Hospital.

Research Tools

- A pre-prepared research form, including sections on: general information, Characteristics of examination according to modern medicine and traditional medicine

- Medical records, ALPK2 blood pressure monitor, stethoscope, tongue depressor, thermometer, stopwatch, and weighing scale, as well as height and weight measuring tools.

Research Content

- Survey of the characteristics of heart patterns according to traditional medicine: Based on the diagnostic guidelines for common syndromes in Traditional Chinese Medicine, a survey was conducted on the occurrence of 12 patterns related to the heart organ: Heart Yin deficiency pattern (HYiDP), Heart Qi deficiency pattern (HQDP), Deficiency of heart Qi and blood pattern (DHQBP), Deficiency of heart Qi and Yin pattern (DHQYiP), Heart Yang deficiency pattern (HYaDP), Deficiency of heart Qi and Yang pattern (DHQYaP), Heart vessels stasis pattern (HVSP), Phlegm obstructing the heart vessels pattern (POHVP), Upward flaming of heart fire pattern (UFHRP), Disharmony between the heart and kidney pattern (DBHKP), Water retention affecting the heart pattern (WRAHP), Heart and spleen deficiency pattern (HSDP). The syndromes were evaluated based on the symptoms present within each syndrome. Each symptom was assigned a different score depending on its importance within the syndrome. The score for each symptom was calculated by multiplying its value by 0.7 (if the symptom was mild), by 1 (if the symptom was moderate), or by 1.5 (if the symptom was severe). The total score for each syndrome was the sum of the scores of all symptoms included in that syndrome. If the total score for a syndrome was 14 points or higher, the syndrome was considered present. If the score was below 14 points, it was considered normal. Within each syndrome, the severity was classified based on the total score: a score of 14–20.9 indicates mild

severity, 21–30 points indicates moderate severity and a score greater than 30 points indicates severe severity [6].

- Investigate the relationship between pro-BNP, EF levels, and the occurrence of heart organ syndromes according to traditional medicine.

Data Analysis and Processing:

The collected data is entered, cleaned, analyzed, and processed using SPSS 20.0 statistical software. Qualitative variables were expressed as percentages. Quantitative variables were presented as mean ± standard deviation (mean ±SD). The normal distribution of variables was tested using the Skewness and Kurtosis indexes. Variables with normal distribution were compared by using One-way ANOVA or Independent-Samples t-test. Variables without normal distribution were compared by using the Kruskal-Wallis H or Mann-Whitney U test. Results were considered statistically significant if p-value <0.05.

Research Ethics

This research was the product of the University-level science and technology project (University of Medicine and Pharmacy, Hue University) with code 102/24, which has been evaluated and licensed by the council. The study was conducted only after obtaining informed consent from the research participants. All collected information was kept confidential and used solely for research purposes.

III. RESULTS

General characteristics of the study subjects

Table 1. General characteristics of the study subjects

Characteristics		n = 180	%
Gender	Male	79	43.9
	Female	101	56.1
Age	< 40	0	0.0
	40- 59	31	17.2
	60-69	49	27.2
	70-79	49	27.2
	≥ 80	51	28.4
	Mean±SD	71.9±12.4	
BMI (kg/m^2)	<18,5	27	15.0
	18,5- 22,9	93	51.7
	≥23	60	33.3
	Mean ±SD	21.8±3.3	

The proportion of females (56.1%) was higher than that of males (43.9%). All research participants were over 40 years old, with an average age of 71.9 ± 12.4 years. In terms of body mass index (BMI), the highest proportion of participants fell within the normal weight range (51.7%), while a significant proportion were overweight or obese (33.3%).

3.2. Characteristics of heart patterns

Table 2. Distribution of heart patterns

Patterns	Total (n = 180)		CCS (n=62) (a)		CHF (n= 59) (b)		CCS + CHF (n= 59) (c)		p (a-b-c)
	n	%	n	%	n	%	n	%	
HYiDP	98	54.4	34	54.8	30	50.8	34	57.6	0.759
HQDP	152	84.4	56	90.3	46	78.0	50	84.7	0.172
DHQBP	161	89.4	60	96.8	51	86.4	50	84.7	0.065
DHQYiP	157	87.2	57	91.9	49	83.1	51	86.4	0.335
HYaDP	101	56.1	38	61.3	31	52.5	32	54.2	0.587
DHQYaP	141	78.3	51	82.3	43	72.9	47	79.7	0.437

Patterns	Total (n = 180)		CCS (n=62) (a)		CHF (n= 59) (b)		CCS + CHF (n= 59) (c)		p (a-b-c)
	n	%	n	%	n	%	n	%	
HVSP	63	35.0	21	33.9	19	32.2	23	39.0	0.723
POHVP	92	51.1	39	62.9	26	44.1	27	45.8	0.071
UFHRP	2	1.1	0	0.0	1	1.7	1	1.7	0.546
DBHKP	77	42.8	31	50.0	22	37.3	24	40.7	0.341
WRAHP	128	71.1	46	74.2	42	71.2	40	67.8	0.740
HSDP	127	70.6	52	83.9	35	59.3	40	67.8	0.011

Notes: *Heart Yin deficiency pattern (HYiDP), Heart Qi deficiency pattern (HQDP), Deficiency of heart Qi and blood pattern (DHQBP), Deficiency of heart Qi and Yin pattern (DHQYiP), Heart Yang deficiency pattern (HYaDP), Deficiency of heart Qi and Yang pattern (DHQYaP), Heart vessels stasis pattern (HVSP), Phlegm obstructing the heart vessels pattern (POHVP), Upward flaming of heart fire pattern (UFHRP), Disharmony between the heart and kidney pattern (DBHKP), Water retention affecting the heart pattern (WRAHP), Heart and spleen deficiency pattern (HSDP).*

HQDP, DHQBP, and DHQYiP were the most common patterns, with prevalence rates above 80%. The next most common syndromes were HYiDP, HYaDP, DHQYaP, POHVP, WRAHP, and HSDP, all of which appeared at relatively high rates (above 50%). The least common pattern, UFHRP, was observed in only 1.1% of cases.

Overall, most of the heart organ patterns showed no significant differences in distribution across the three patient groups ($p > 0.05$). However, HSDP exhibited a significant difference between the three groups ($p < 0.05$).

Table 3. Degree of heart patterns

Patterns %		Total (n = 180)		CCS (n=62) (1)		CHF (n= 59) (2)		CCS + CHF (n= 59) (3)		p (1-2-3)
		X±SD	%	X±SD	%	X±SD	%	X±SD		
HYiDP	mild	43.3	14.6 ± 5.7	43.5	14.8 ± 4.7	37.3	14.4 ± 6.6	49.2	14.6 ± 5.6	0.908
	moderate	9.4		11.3		8.5		8.5		
	severe	1.7		0.0		5.1		0.0		
HQDP	mild	33.3	20.5 ± 6.5	37.1	20.5 ± 4.8	27.1	20.9 ± 7.1	35.6	20.0 ± 7.4	0.809
	moderate	46.1		53.2		42.4		42.4		
	severe	5.0		0.0		8.5		6.8		
DHQBP	mild	29.4	21.5 ± 6.1	19.4	22.8 ± 3.8	42.4	20.5 ± 6.8	27.1	21.2 ± 7.2	0.052
	moderate	53.3		77.4		35.6		45.8		
	severe	6.7		0.0		8.5		11.9		
DHQYiP	mild	32.8	21.3 ± 6.9	32.3	21.1 ± 5.2	39.0	21.3 ± 7.8	27.1	21.4 ± 7.6	0.974
	moderate	45.6		58.1		28.8		49.2		
	severe	8.9		1.6		15.3		10.2		
HYaDP	mild	42.2	15.1 ± 5.3	46.8	15.3 ± 4.6	33.9	15.5 ± 6.3	45.8	14.6 ± 4.8	0.588
	moderate	13.3		14.5		16.9		8.5		
	severe	0.6		0.0		1.7		0.0		

Patterns %		Total (n = 180)		CCS (n=62) (1)		CHF (n= 59) (2)		CCS + CHF (n= 59) (3)		p (1-2-3)
		X±SD	%	X±SD	%	X±SD	%	X±SD		
DHQYaP	mild	52.8	18.3 ± 13.1	64.5	17.2 ± 3.9	40.7	17.8 ± 6.2	52.5	19.7 ± 21.7	0.811
	moderate	24.4		17.7		30.5		25.4		
	severe	1.1		0.0		1.7		1.7		
HVSP	mild	23.9	11.1 ± 7.2	25.8	10.7 ± 7.0	15.3	11.6 ± 8.0	30.5	11.0 ± 6.6	0.788
	moderate	10.6		8.1		15.3		8.5		
	severe	0.6		0.0		1.7		0.0		
POHVP	mild	36.7	14.4 ± 6.5	53.2	15.1 ± 6.1	27.1	14.2 ± 6.5	28.8	13.9 ± 7.0	0.518
	moderate	11.7		4.8		9 15.3		15.3		
	severe	2.8		4.8		1.7		1.7		
UFHRP	mild	1.1	5.5 ± 3.3	0.0	6.1 ± 3.0	1.7	5.7 ± 3.7	1.7	4.8 ± 3.1	0.087
	moderate	0.0		0.0		0.0		0.0		
	severe	0.0		0.0		0.0		0.0		
DBHKP	mild	37.8	13.3 ± 4.3	50.0	13.8 ± 3.4	28.8	13.0 ± 5.0	33.9	13.1 ± 4.4	0.473
	moderate	5.0		0.0		8.5		6.8		
	severe	0.0		0.0		0.0		0.0		
WRAHP	mild	43.9	17.3 ± 5.7	67.7	15.8 ± 4.2	28.8	18.3 ± 6.0	33.9	17.8 ± 6.4	p_{2-3}=0.02
	moderate	25.6		6.5		40.7		30.5		
	severe	1.7		0.0		1.7		3.4		
HSDP	mild	55.6	16.1 ± 4.5	72.6	17.1 ± 2.9	45.8	15.2 ± 5.0	47.5	15.9 ± 5.1	0.08
	moderate	15.0		11.3		13.6		20.3		
	severe	0.0		0.0		0.0		0.0		

Notes: *Heart Yin deficiency pattern (HYiDP), Heart Qi deficiency pattern (HQDP), Deficiency of heart Qi and blood pattern (DHQBP), Deficiency of heart Qi and Yin pattern (DHQYiP), Heart Yang deficiency pattern (HYaDP), Deficiency of heart Qi and Yang pattern (DHQYaP), Heart vessels stasis pattern (HVSP), Phlegm obstructing the heart vessels pattern (POHVP), Upward flaming of heart fire pattern (UFHRP), Disharmony between the heart and kidney pattern (DBHKP), Water retention affecting the heart pattern (WRAHP), Heart and spleen deficiency pattern (HSDP).*

The syndromes HYiDP, HYaDP, DHQYaP, HVSP, POHVP, and DBHKP all had the highest proportion of "mild severity" across all three patient groups. The syndromes HQDP, DHQBP, and DHQYiP predominantly appeared with "moderate severity" in all three groups, and had the highest average scores among the 12 syndromes, ranging from 20.0 ± 7.4 to 22.8 ± 3.8.

There was a difference in the mean score of the WRAHP between the CHF group and the CCS+CHF group ($p<0.05$).

3.3. The relationship between pro-BNP and EF index with the occurrence of heart organ syndromes in patients with cardiovascular diseases

Table 4. The relationship between pro-BNP and EF index with the occurrence of heart organ syndromes

Patterns		CCS		CHF		CCS + CHF		p
		pro-BNP (1)	EF (2)	pro-BNP (3)	EF (4)	pro- BNP (5)	EF (6)	
HYiDP	Yes	873.2 ± 1092.9	67.0 ± 6.0	4934.7± 6066.2	55.0 ± 16.0	7704.3± 9611.1	50.0 ± 14.0	>0.05
	No	521.6 ± 447.4	66.0 ± 8.0	5265.9± 7021.2	57.0 ± 13.0	5356.6± 9256.9	54.0 ± 16.0	
HQDP	Yes	210.2 ± 247.6	68.0 ± 7.0	4930.4± 7320.6	58.0 ± 15.0	6843.6± 11647.1	49.0 ± 12.0	>0.05
	No	814.4 ± 896.8	66.0 ± 8.0	5144.0± 6305.9	55.0 ± 14.0	6233.7± 9105.6	53.0 ± 16.0	
DHQBP	Yes	112.2 ±85.6	64.0 ± 4.0	6024.0± 9053.2	56.0 ± 14.0	3836.8± 3900.0	48.0 ± 9.0	>0.05
	No	745.0 ± 860.4	66.0 ± 8.0	4939.5± 6070.2	56.0 ± 14.0	6796.5± 10066.3	53.0 ± 16.0	
DHQYiP	Yes	302.0 ± 268.4	64.0 ± 4.0	6237.9± 8223.7	53.0 ± 16.0	7082.8± 12559.0	51.0 ± 11.0	>0.05
	No	761.9 ± 887.8	67.0 ± 8.0	4845.9± 6126.5	56.0 ± 14.0	6212.0± 9011.5	52.0 ± 16.0	
HYaDP	Yes	768.9 ± 964.6	68.0 ± 6.0	4922.5± 6228.5	55.0 ± 16.0	9535.7± 11876.7	49.0 ± 14.0	$p_{1;2;3;4;6}$>0.05 p_5<0.05
	No	665.0 ± 806.4	66.0 ± 8.0	5266.3± 6843.6	57.0 ± 13.0	3728.2± 5764.6	54.0 ± 15.0	
	Yes	118.3 ± 82.8	67.0 ± 6.0	4691.9± 6945.5	57.0 ± 15.0	6824.8± 10360.2	46.0 ± 11.0	$p_{2;3;4;5;6}$>0.05 p_1<0.05
	No	889.1 ± 896.4	66.0 ± 8.0	5255.5± 6377.8	55.0 ± 14.0	6197.7± 9259.1	53.0 ± 16.0	
HVSP	Yes	808.0 ± 902.2	66.0 ± 7.0	5092.5± 5584.2	56.0 ± 15.0	7569.7± 10234.9	54.0 ± 15.0	>0.05
	No	239.8 ± 224.5	66.0 ± 9.0	5098.6± 8260.0	56.0 ± 12.0	4390.8± 7737.2	49.0 ± 15.0	
POHVP	Yes	889.9 ± 1129.2	67.0 ± 6.0	4549.8± 5781.0	55.0 ± 15.0	7071.6± 10169.2	51.0 ± 15.0	>0.05
	No	545.8 ± 506.5	66.0 ± 8.0	5875.9± 7447.8	57.0 ± 13.0	5454.5± 8517.3	53.0 ± 15.0	
UFHRP	Yes	707.8 ± 847.1	66.0 ± 7.0	5133.3± 6539.0	56.0 ± 14.0	6428.7± 9441.0	52.0 ± 15.0	>0.05
	No	-	-	2956.0 ± 0.0	67.0 ± 0.0	388.1 ±0.0	65.0 ±0.0	
DBHKP	Yes	644.3 ± 921.6	65.0 ± 7.0	5798.9± 7400.5	54.0 ± 15.0	7081.7± 9757.2	49.0 ± 14.0	$p_{1;2;3;4;5}$>0.05 p_6<0.05
	No	764.1 ± 827.1	67.0 ± 8.0	3722.5± 3999.0	58.0 ± 13.0	5229.1± 8934.0	57.0 ± 15.0	
WRAHP	Yes	1008.6 ± 922.8	69.0 ± 4.0	3818.6± 6438.7	56.0 ± 17.0	7563.3± 9935.5	52.0 ± 14.0	$p_{1;3;4;5;6}$>0.05 p_2<0.05
	No	543.7 ± 798.9	65.0 ± 8.0	5650.6± 6510.3	56.0 ± 13.0	5732.3± 9197.4	52.0 ± 15.0	

Patterns		CCS		CHF		CCS + CHF		p
		pro-BNP (1)	EF (2)	pro-BNP (3)	EF (4)	pro- BNP (5)	EF (6)	
HSDP	Yes	210.2 ± 247.6	63.0 ± 9.0	4974.9± 6412.8	55.0 ± 14.0	6177.9± 6129.3	45.0 ± 11.0	$p_{1;2;3;4;5}>0.05$ $p_6<0.05$
	No	814.4 ± 896.8	67.0 ± 7.0	5177.7± 6634.0	56.0 ± 14.0	6388.5± 10666.7	55.0 ± 16.0	

Notes: *Heart Yin deficiency pattern (HYiDP), Heart Qi deficiency pattern (HQDP), Deficiency of heart Qi and blood pattern (DHQBP), Deficiency of heart Qi and Yin pattern (DHQYiP), Heart Yang deficiency pattern (HYaDP), Deficiency of heart Qi and Yang pattern (DHQYaP), Heart vessels stasis pattern (HVSP), Phlegm obstructing the heart vessels pattern (POHVP), Upward flaming of heart fire pattern (UFHRP), Disharmony between the heart and kidney pattern (DBHKP), Water retention affecting the heart pattern (WRAHP), Heart and spleen deficiency pattern (HSDP).*

There was a correlation between pro-BNP levels and the occurrence of the DHQYaP syndrome, specifically: the pro-BNP levels in the group with DHQYaP syndrome were higher than those in the group without this syndrome ($p < 0.05$).

There was a correlation between the EF index and the occurrence of the WRAHP syndrome, specifically: the EF in the group with WRAHP syndrome was lower than that in the group without this syndrome ($p < 0.05$).

There was a correlation between pro-BNP levels and the occurrence of the HYaDP syndrome, specifically: the pro-BNP levels in the group with HYaDP syndrome were higher than those in the group without this syndrome ($p < 0.05$).

There was a correlation between the EF index and the occurrence of the DBHKP and HSDP syndromes, specifically: the EF in the groups with DBHKP and HSDP syndromes was higher than that in the groups without these syndromes ($p < 0.05$).

IV. DISCUSSION

Characteristics of heart organ patterns

Regarding the frequency distribution of heart organ syndromes according to traditional medicine in cardiovascular diseases, our study found that the syndromes of HQDP (84.4%), DHQBP (89.4%), and DHQYiP (87.2%) were the most commonly observed. The least prevalent syndrome was UFHRP, which occurred in only 1.1% of cases. Furthermore, we noted that the syndromes of HQDP, DHQBP, and DHQYiP were predominantly of moderate severity, with prevalence rates ranging from 42.4% to 58.1%. These syndromes also had the highest average severity scores, with values ranging from 20.0 ± 7.4 to 22.8 ± 3.8. Thus, it can be concluded that the syndromes of HQDP, DHQBP, and DHQYiP were not only frequently encountered but also tended to have a greater impact compared to the other syndromes. HYiDP, HYaDP, DHQYaP, HVSP, POHVP, and DBHKP all exhibited a predominance of “mild severity,” with the highest prevalence rates. According to traditional medicine, cardiovascular diseases are fundamentally caused by root (Ben) deficiency with the excessive branch (Biao): root deficiency refers to the deficiency of the body’s fundamental substances (Yin, Yang, Qi, and Blood). The Heart, which governs the Blood, is particularly important in this context, any pathological changes in the Heart directly affect the Blood, Blood deficiency weakens the Heart’s ability to promote circulation (Heart Qi), and as the Blood deficiency progresses, it can gradually lead to Yin deficiency. On the other hand, Yang deficiency primarily progresses from Qi deficiency, which exacerbates the condition. Excessive Biao in traditional medicine refers to the pathological processes of cold stagnation, phlegm dampness, water dampness, and blood stasis. During a certain stage, the clinical manifestations of coronary artery disease and heart failure may appear relatively stable. However, as the condition progresses, the location and nature of the disease can change in a complex manner, and the symptoms may transform or interact with each other. Therefore, the classification of the severity of the disease is

primarily based on the degree of Ben deficiency with excessive Biao, the severity of pathogenic excess, and the extent of damage to the organs. If there is a deficiency in Qi, Blood, Yin, and Yang without the presence of blood stasis, phlegm-dampness, or water dampness, the disease is considered to manifest at a mild level. If accompanied by signs of excessive Biao, the disease has progressed to a moderate or severe stage. Clinically, this is often manifested as a mix of deficiency and excess. The syndrome of UFHRP appeared at the lowest prevalence. The pathogenesis of this syndrome is primarily due to excessive heart fire, which strongly consumes the body's vital substances, leading to the transformation of the five emotions and six pathogenic factors into fire (excessive Biao and Ben). This mechanism differs from the predominant pattern of Ben deficiency with excessive Biao typically seen in cardiovascular diseases in general. Overall, the distribution of the aforementioned Heart organ syndromes showed no significant differences between the three disease groups.

The WRAHP in CCS and the group with both diseases were most commonly observed at a mild severity level, with prevalence rates of 67.7% and 33.9%, respectively. However, in the HF group, it appeared with moderate severity in the highest proportion (40.7%). This can be explained by the differences in the role of water and dampness in the pathogenesis of these two conditions. In CHF, water and dampness were key factors in excessive branches, whereas, in CCS, water and dampness primarily arise as a result of damage to the Yang aspects of the heart and kidney organs. Therefore, there was a significant difference in the severity of WRAHP across the three disease groups ($p < 0.05$) [7].

4.2. The relationship between pro-BNP and EF levels and the occurrence of heart organ syndromes in cardiovascular patients.

The primary biological effects of pro-BNP include natriuresis, diuresis, peripheral vasodilation, and the inhibition of the renin-angiotensin-aldosterone system as well as the sympathetic nervous system. An increase in myocardial wall stress is a strong stimulus for the release of pro-BNP into the bloodstream. The secretion of serum pro-BNP levels may be associated with the concept of Cold obstruction in traditional medicine. Cold is a Yin pathogen, characterized by its ability to induce stagnation and constriction, leading to the obstruction of Qi circulation and the contraction of the meridians. Cold is also associated with water-Qi, which is connected to the kidneys. When cold pathogens invade the body, they cause an accumulation of cold and water, which can result in reduced urine output. Therefore, higher levels of pro-BNP are released to balance endovascular volume, and osmolality, and regulate systemic circulatory pressure in patients with the DHQYaP. This mechanism may explain why patients with DHQYaP exhibit significantly higher pro-BNP levels compared to those without this syndrome ($p < 0.05$).

Ejection fraction (EF) is an index used to evaluate the heart's pumping function, calculated as the percentage of blood ejected from the heart with each beat. When EF is low, the kidneys receive less blood than usual, impairing the body's ability to eliminate salt and water. This retention increases blood volume, placing additional strain on the heart. This may relate to the mechanism of the WRAHP in traditional medicine: prolonged DHQYaP disrupts the harmony between Yin and Yang, weakening the connection between the heart and kidneys. This affects the function of the kidney Yang, which, when deficient, cannot effectively transform water. Consequently, water and dampness accumulate internally, rising upward and obstructing the heart organ and vessels. The diminished activating function of the heart organ results in reduced contractility and circulation. Consequently, the EF in individuals with the WRAHP was significantly lower than in those without this pattern ($p < 0.05$). Kidney Yin is the foundation of Yin fluids in the body, providing nourishment and moisture to the organs and tissues. In patients with DBHKP, kidney Yin deficiency leads to internal heat, depleting bodily fluids. This mechanism contrasts sharply with that of the WRAHP, as it reduces circulatory volume and lessens the burden on the heart. Consequently, EF in individuals with the heart-kidney disharmony pattern was higher than in those without this pattern. Spleen Qi deficiency leads to Heart Blood deficiency, reducing circulatory volume and thereby lessening the heart's workload. This explains why individuals with the HSDP across all three disease groups had a higher EF compared to those without this pattern. Given that EF was lower in patients with both CHF and CCS than in those with either condition alone, the EF difference between patients

with and without these two patterns became more pronounced in those with both diseases ($p < 0.05$).

V. CONCLUSIONS

The most commonly observed syndromes were HQDP, DHQBP, and DHQYiP, followed by HYiDP, HYaDP, DHQYaP, POHVP, WRAHP, HSDP, and, with the lowest prevalence, UFHRP. The syndromes HYiDP, HYaDP, DHQYaP, HVSP, UFHRP, and DBHKP mostly appeared with mild severity. The syndromes HQDP, DHQBP, and DHQYiP mostly appeared with moderate severity and had the highest average severity scores. In CCS, the pro-BNP level was higher in the group with DHQYaP and the EF was lower in the group with WRAHP. In patients with both CCS and CHF, the pro-BNP level was lower in the group with HYaDP, and the EF was higher in the groups with DBHKP and HSDP.

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QUALITY OF LIFE OF ELDERLY PATIENTS AFTER HUMERAL SHAFT PLATE FIXATION SURGERY AT THAI BINH PROVINCIAL GENERAL HOSPITAL

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ABSTRACT

Objective: To assess the quality of life (QoL) of elderly patients with closed humeral shaft fractures treated with internal fixation at Thai Binh Provincial General Hospital.

Method: A cross-sectional descriptive study was conducted on 55 elderly patients with closed humeral shaft fractures, who underwent internal fixation with plate and screws at Thai Binh Provincial General Hospital from January 2020 to March 2024. The EQ-5D-5L scale was used to assess the quality of life of elderly patients.

Results: The quality of life index of the study group was 0.71±0.18 (ranging from 0.26 to 0.94), lower than the quality of life of the elderly population in the community. The quality of life increased in correlation with the level of functional recovery of the patients (p=0.000). Factors associated with poorer quality of life included advanced age (p=0.000), low educational level (p=0.018), no longer working (p=0.035), multiple chronic diseases (p=0.002), and associated injuries at the time of fracture (p=0.009).

Conclusions: The quality of life of patients after treatment for humeral shaft fractures using plate fixation was lower than that of the general elderly population. Factors negatively impacting quality of life, as recorded in this study, included advanced age, low educational attainment, lack of employment, multiple chronic diseases, and associated injuries at the time of the fracture.

Keywords: *Humeral shaft fracture, elderly, EQ-5D-5L*

I. INTRODUCTION

A humeral shaft fracture is defined as a break in the upper arm bone extending from the surgical neck, near the attachment of the pectoralis major muscle, to the region above the two epicondyles, where the bone begins to widen. Such fractures directly affect the function of the upper limb, impacting the patient's quality of life, particularly in the elderly population [1].

The use of plate and screw fixation in the treatment of humeral fractures is common in provincial hospitals and has generally shown favorable outcomes. However, previous studies on humeral shaft fractures in Vietnam have mostly focused on surgical outcomes and functional recovery, with limited attention given to the quality of life of elderly patients after surgical fixation [2]. This study aims to evaluate various factors related to the quality of life in elderly patients following humeral shaft fracture surgery using plate and screw fixation, with the goal of improving the quality of life for this patient group.

II. SUBJECTS AND METHODS

2.1. Study area and duration of time

Study area: Department of Orthopedics and Burns, Thai Binh General Hospital

Duration of time: from January 2020 to March 2024

2.2. Study subjects

55 elderly patients with humeral shaft fractures who underwent internal fixation with plate and screws and participated in follow-up visits during the study period.

2.3. Research methodology

A cross-sectional descriptive study was conducted, evaluating post-surgical outcomes over a period ranging from 7 to 53 months.

Quality of life: is a multidimensional concept that encompasses an individual's overall physical, mental, emotional, and social well-being. It reflects how individuals perceive their position in life within the context of their culture, values, goals, expectations, and standards.

The EQ-5D-5L (EuroQol 5-Dimensions 5-Levels) scale is widely used for assessing health-related quality of life (HRQoL). It provides a comprehensive yet simple tool to evaluate outcomes in various medical conditions, including orthopedic injuries such as humeral shaft fractures. In elderly patients, the EQ-5D-5L scale can be instrumental in understanding the broader impact of closed humeral shaft fractures on their health status.

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2.4. Statistical analysis

The collected data were encoded and entered into EPIDATA 3.1 software and subsequently exported to SPSS 20.0 for statistical analysis. The research findings were presented in the form of frequency tables and percentages (%), as well as mean values and standard deviations. The Chi-square test was employed to compare differences in percentages, while the t-student test was used to compare differences in the mean values of two normally distributed quantitative variables. Statistical significance was determined at a p-value of < 0.05.

2.5 Ethical research

The research was conducted only after receiving approval from the Ethics Committee of Thai Binh University of Medicine and Pharmacy, and the technical procedures were authorized by Thai Binh General Hospital. Participants were thoroughly informed about the purpose and content of the study. Survey questionnaires were distributed only after participants had signed the consent form. During the interview process, any refusal from participants was fully respected and accepted.

III. STUDY RESULTS

Table 1. Some general characteristics of the patients (n=55)

Characteristics		Number	Percentage %
Age group	60-69	24	43.6
	70-79	22	40.0
	≥80	9	16.4
Gender	Male	23	41.8
	Female	32	58.2
Residence	Urban	10	18.2
	Rural	45	81.8
Education level	Primary - Secondary school	28	50.9
	High school	21	38.2
	College, University	6	10.9
Occupation	Employed	21	38.2
	Not employed	34	61.8
Co-habitants	Spouse	26	47.3
	Children/ Grandchildren/ relatives	28	50.9
	Living alone	1	1.8

The age group 60-69 years accounted for the highest percentage (43.6%), with females representing 58.2%. The majority of patients were from rural areas (81.1%). Most patients had an educational level of primary or lower secondary school (50.9%), and the majority were no longer employed (61.8%). Most patients lived with children/grandchildren/relatives (50.9%) or with a spouse (47.3%)

Table 2. Clinical and X-ray characteristics of humeral shaft fractures (n=55)

Characteristics		Number	Percentage %
Fracture causes	Household accidents	33	60.0
	Traffic accidents	21	38.2
	Occupational accidents	1	1.8
	Violence	0	0.0

Characteristics		Number	Percentage %
Fracture location	Upper third	20	36.4
	Middle third	16	29.1
	Lower third	19	34.5
AO classification	A	28	50.9
	B	16	29.1
	C	11	20.0
Number of comorbid chronic diseases	0	12	21.8
	1-2	24	43.6
	≥3	19	34.5
Number of associated injuries	0	33	60.0
	1-2	14	25.5
	≥3	8	60.0

Household accidents account for the highest proportion of fractures, at 60.0%. The majority of fractures occur in the upper third (36.4%) and lower third (34.5%) of the affected area. According to the AO classification, Type A fractures are the most common, representing 50.9% of cases. Most patients have one or two concomitant chronic conditions, comprising 43.6% of the sample. A majority of patients (60.0%) do not have associated injuries.

Table 3. Association between certain epidemiological factors and quality of life

Factors	Number	EQ-5D-5L Index		
		Mean	SD	p
Age group				
60-69	24	0.82	0.13	0.000
70-79	22	0.68	0.15	
≥80	9	0.47	0.14	
Gender				
Male	23	0.73	0.18	0.502
Female	32	0.69	0.19	
Education level				
Primary - Secondary school	28	0.64	0.19	0.018
High school	21	0.77	0.14	
College. University	6	0.80	0.16	
Occupations				
Employed	21	0.77	0.18	0.035
Not employed	34	0.67	0.18	
Residence				
Urban	10	0.76	0.14	0.310
Rural	45	0.69	0.19	
Co-inhabitants				
Spouse	26	0.78	0.16	0.015
Children/ Grandchildren/ relatives	28	0.64	0.18	
Living alone	1	0.56	-	

As age increases, the quality of life decreases. Quality of life improves with higher educational attainment. Patients who are still employed report a higher quality of life compared to those who are no longer employed. Additionally, patients living with a spouse have a higher quality of life than those living with children, relatives, or alone; this difference was statistically significant ($p < 0.05$). Male patients have a higher quality of life than female patients, and patients living in urban areas have a higher quality of life compared to those in rural areas. However, this latter difference was not statistically significant ($p > 0.05$).

Table 4. Association between certain fracture characteristics and quality of life

Factors	Number	EQ-5D-5L Index		
		Mean	SD	p
Fracture causes				
Household accidents	33	0.68	0.18	0.313
Traffic accidents	21	0.75	0.19	
Occupational accidents	1	0.81	0	
Violence	0	0	0	
Fracture location				
Upper third	20	0.70	0.20	0.579
Middle third	16	0.74	0.17	
Lower third	19	0.68	0.17	
AO classification				
A	28	0.68	0.18	0.321
B	16	0.71	0.19	
C	11	0.78	0.17	
Number of comorbid chronic diseases				
0	12	0.74	0.21	0.002
1-2	24	0.78	0.13	
≥3	19	0.59	0.17	
Number of associated injuries				
0	33	0.74	0.15	0.009
1-2	14	0.72	0.19	
≥3	8	0.53	0.22	

There were no statistically significant differences in quality of life between patient groups with different fracture causes, fracture locations, or AO classifications. However, in patients with multiple comorbid chronic conditions or concomitant injuries, the quality of life was lower. This difference was statistically significant ($p < 0.05$).

Table 5. Quality of Life of patients according to the EQ-5D-5L scale (n=55)

Functional recovery according to the modified NEER classification	Number		EQ-5D-5L index		p
	n	%	Mean	SD	
Very good	41	74.5	0.77	0.14	0.000
Good	10	18.2	0.58	0.14	
Average	4	7.3	0.37	0.14	
Poor	0	0	0	0	
Total	0	100	0.71	0.18	
Mean ± SD	0.71±0.18 (0.26-0.94)				

The quality of life index of patients, as measured by the EQ-5D-5L scale, at the follow-up visit was 0.71 ± 0.18. The highest score recorded was 0.94, and the lowest was 0.26. The quality of life index increased progressively with the degree of functional recovery of the patients, and this difference was statistically significant ($p < 0.05$).

IV. DISCUSSIONS

In our study, the quality of life index, as measured by the EQ-5D-5L scale, at the follow-up visit was 0.71 ± 0.18. The highest score recorded was 0.94, and the lowest was 0.26. The quality of life index increased progressively with the degree of functional recovery of the patients, and this difference was statistically significant ($p < 0.05$).

The results of our study are lower than those reported in the study by Vu Minh Tuan (2021) [1] which included 200 elderly individuals in Thach Than Commune, Quoc Oai District, Hanoi, where the quality of life index was 0.77 ± 0.13. The quality of life of elderly patients after humeral fracture surgery is lower than that of healthy elderly individuals in the general population due to the combination of several factors: reduced mobility and ability to perform daily tasks, prolonged pain, surgical complications, and negative psychological impacts, all of which contribute to the decline in quality of life. Therefore, the treatment and care of elderly patients following humeral fracture surgery should be comprehensive, addressing both physical and mental health factors, in order to improve the quality of life for this population.

Our EQ-5D-5L index is significantly higher compared to the study by Vu Minh Hai [2], in which the quality of life of patients with bone fractures was reported to be 0.23. This difference can be explained by the fact that the participants in our study were patients who had undergone surgical intervention, with stable fixation and functional rehabilitation, resulting in better quality of life outcomes compared to those still in the process of treatment for bone fractures. These findings are consistent with previous studies that have demonstrated a significant improvement in the quality of life of patients between the periods of hospitalization, discharge, and follow-up visits [3], [4].

According to the study by Den Hartog et al. (2022) [3] on 390 patients with humeral shaft fractures (145 treated conservatively, 245 surgically), the average quality of life index at 3 months post-treatment was 0.72 for the conservative treatment group and 0.77 for the surgical treatment group. These results are higher than those of our study. The research team suggests that this difference is largely influenced by age (the average age of the surgical group was 53 years, compared to 72.5 ± 8.2 years in our study). Den Hartog observed significant improvements in quality of life over time for both groups at the 2-week, 6-week, 3-month, 6-month, and 12-month follow-ups. In this study, the authors employed a prospective, interventional, descriptive clinical research design with longitudinal follow-up, comparing pre- and post-operative outcomes. Patients were monitored regularly, encouraged to engage in early functional rehabilitation, and provided with structured guidance, which likely contributed to the better quality of life outcomes observed. Therefore, it is essential to routinely monitor and assess the quality of life of patients in order to identify emerging issues and address any challenges they may face, ultimately optimizing recovery outcomes.

According to the study by Oliver et al. (2022) [4] on 291 patients with humeral shaft fractures, the mean EQ-5D quality of life index was 0.73. Among these, the index for the group with bone healing after initial surgery (62 patients) was 0.76 ± 0.25, for those with healing after conservative treatment (165 patients) was 0.77 ± 0.27, for those with healing after a second surgery following failure of conservative treatment (52 patients) was 0.64 ± 0.34, and for the non-union group after two interventions (10 patients) was 0.51 ± 0.37. Therefore, the quality of life index in our study is lower compared to the group that healed after the first treatment but higher than the non-union group after the first treatment. The research team suggests that this difference may be attributed to the longer follow-up period in Oliver's study (an average of 5.5 years), which is considerably longer than in our study. Moreover, the age range in Oliver's study spanned from 17 to 86 years, while in our study, all patients were elderly. As discussed earlier, elderly patients generally require more time to recover post-surgery compared to younger individuals. Therefore, at 6 months post-surgery, in addition to evaluating the bone healing status of patients, physicians should also assess quality of life in order to determine the

appropriate supportive measures for treatment, rehabilitation, and care, which will help optimize recovery during the subsequent stages.

According to Oliver [4], the quality of life index for the group with bone healing following conservative treatment is higher than that of the group with healing after surgery initially. However, the non-union rate after conservative treatment is significantly higher compared to surgical treatment (26.4% vs. 3.1%). Consequently, the quality of life is diminished due to the prolonged suffering from illness and pain, which also increases the financial burden due to ineffective treatment, the need for method conversion, and delayed return to work, resulting in lost economic productivity. Additionally, there is an opportunity cost in terms of time and resources when patients experience delays in returning to daily activities and productive labor. These results demonstrate that early surgical intervention in the treatment of humeral shaft fractures improves long-term outcomes, reduces treatment costs, and significantly enhances the quality of life of patients. Therefore, plate and screw fixation is the recommended treatment approach for humeral shaft fractures.

According to the results of our study, as age increases, the quality of life decreases, with this difference being statistically significant ($p < 0.05$). This can be explained by the fact that advanced age affects multiple aspects of quality of life, such as diminishing certain physical functions, leading to a gradual decline in health, as well as influencing psychological, emotional, and social interactions in elderly individuals. Quality of life improves with higher educational levels. Furthermore, the quality of life is higher in the group of patients still engaged in work compared to those who are no longer employed. Additionally, patients living with a spouse report better quality of life than those living with children, relatives, or alone; this difference is also statistically significant ($p < 0.05$). Moreover, in patients with multiple concomitant injuries or numerous comorbid chronic conditions, the quality of life is significantly lower, with statistical significance. These findings are consistent with the study on quality of life in the elderly by Vũ Minh Tuấn [1]. Comorbid chronic diseases present a significant challenge in providing care and treatment services for the elderly and are an important predictor of quality of life decline in this population.

V. CONCLUSION

The quality of life of elderly patients following surgical treatment with plate and screw fixation for humeral shaft fractures is low. The quality of life improves progressively in relation to the degree of functional recovery of the patient. Poorer quality of life is associated with advanced age, multiple comorbidities, and concomitant injuries.

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ASSOCIATED FACTORS AND OUTCOMES OF THREATENED MISCARRIAGE IN PREGNANT WOMEN AT THAI BINH OBSTETRICS AND GYNECOLOGY HOSPITAL FROM 2022 TO 2023

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ABSTRACT

Objective: Evaluation of Treatment Outcomes for Threatened Miscarriage up to 12 Weeks at Thai Binh Obstetrics and Gynecology Hospital in the Years 2022-2023.

Method: A cross-sectional study was conducted on 260 pregnant women diagnosed with threatened abortion and treated at Thai Binh Maternity Hospital from January 1, 2022, to June 30, 2023.

Results: The results indicated a treatment success rate of 86.5%, with various protocols applied, primarily involving hormone therapy combined with tocolysis. Notably, the analysis of treatment outcomes by maternal age revealed no significant differences between patients aged ≤ 35 years and those aged > 35 years ($p > 0.05$). However, while maternal age did not show a statistically significant impact on treatment outcomes, some studies suggest it may still be a potential risk factor for complications. Additionally, the presence of subchorionic fluid was assessed, showing that 57.3% of patients had this condition. Although the treatment success rate was slightly higher in patients without subchorionic fluid (90.1% vs. 83.9%), no statistically significant relationship was established ($p > 0.05$). These findings imply that neither maternal age nor the presence of subchorionic fluid significantly affects treatment outcomes for threatened abortion, highlighting the effectiveness of medical interventions regardless of these factors.

Conclusion: Although the group of pregnant women over 35 years old and patients with subchorionic fluid had a higher rate of treatment failure, no significant association was identified. This indicates that these factors do not significantly affect treatment outcomes.

Keywords: *threatened abortion, severe obstetric history, Thai Binh Obstetrics and Gynecology Hospital.*

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I. INTRODUCTION

To ensure the birth of a healthy baby, mothers must navigate various risks throughout the 9-month and 10-day gestation period. One critical issue that demands special attention is threatened miscarriage. This condition not only impacts the health of the pregnant woman but also significantly affects her mental well-being, her family's stability, and the overall quality of the population.

Miscarriage is defined as the termination of pregnancy before 22 weeks of gestation or when the fetus weighs less than 500 grams. It typically unfolds in two stages: threatened miscarriage and actual miscarriage. During the threatened miscarriage stage, the gestational sac has not yet detached from the uterine lining, and with prompt treatment, the chances of continuing the pregnancy are quite high. However, threatened miscarriage is characterized by symptoms that pose a risk to the fetus's life, especially in the early stages of pregnancy (under 12 weeks).

Investigating the clinical and paraclinical manifestations of threatened miscarriage is crucial. This research not only aids in the early identification of risks but also enables healthcare providers to implement timely interventions, thus supporting a normal pregnancy and safeguarding the health of the mother. Each year, Thai Binh Obstetrics and Gynecology Hospital treats numerous patients with threatened miscarriage. However, it is important to note that there is currently no published data regarding whether treatment outcomes are affected by maternal age or the presence of subchorionic fluid. This gap in knowledge highlights the need for further research to clarify these factors in relation to treatment efficacy.

II. SUBJECTS AND METHODS

2.1 Subjects, Duration, and Location of the Study

Subjects: The study focused on pregnant women diagnosed with threatened abortion and treated at Thai Binh Maternity Hospital, meeting the following criteria:

Inclusion Criteria:

Pregnant with a viable fetus in the uterine cavity.

Gestational age calculated from the first day of the last menstrual period if the cycle is regular (28-30 days) or based on ultrasound in the first trimester.

Diagnosed with threatened abortion.

Exclusion Criteria:

Cases not meeting the inclusion criteria.

Cases currently experiencing miscarriage.

Cases of bleeding in pregnancy due to other causes: missed abortion, molar pregnancy, ectopic pregnancy, etc.

Duration and Location: From January 1, 2022, to June 30, 2023, at Thai Binh Maternity Hospital.

2.2 Research Methods

2.2.1 Study Design

Descriptive cross-sectional study.

2.2.2 Sample Size

Apply the formula for calculating sample size to estimate a proportion using absolute error:

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

p: set at 0.2 according to author Lê Thị Anh Đào [1].

d: desired margin of error, set at 0.05.

Calculated sample size n=245 patients.

(In this study, we obtained 260 patients)

2.2.3 Research Procedure

Each subject was interviewed, examined, and underwent tests according to a standardized medical record template.

2.2.4 Data Entry and Processing

Data were collected and processed using SPSS 20.0 with medical statistical tests.

2.3 Ethical Considerations

The study was approved by the Scientific Council under Decision No. 1444/QĐ-YDTB.

III. RESEARCH RESULTS

Figure 1. Treatment Outcomes

Among the 260 patients treated for threatened miscarriage at the hospital, 225 cases were successfully treated, accounting for a rate of 86.5%.

Table 1. Treatment protocol for patients

Treatment Protocol	Quantity	Percentage (%)
Tocolysis	20	7.7
Hormones + Tocolysis	218	83.8
Tocolysis + Hormones + Antibiotics	18	6.9
Tocolysis + Cervical Cerclage + Antibiotics	4	1.5
Total	260	100

Comments: The protocol using tocolysis and hormones accounted for the highest percentage at 83.8%, followed by tocolysis at 7.7%, with cervical cerclage being the least used protocol.

Table 2. Treatment Outcomes by Maternal Age

Results	Maternal Age ≤ 35		Maternal Age > 35		
	Quantity	Percentage (%)	Quantity	Percentage (%)	
Recovered	200	86,6	25	86,2	p > 0,05
Failure	31	13,4	04	13,8	
Total	231	100	29	100	

There is no significant difference in treatment outcomes between the two maternal age groups (≤ 35 years and > 35 years). Therefore, it can be concluded that maternal age does not significantly affect treatment outcomes.

Table 3. Distribution of Patients with subchorionic fluid on Ultrasound

Ultrasound Findings	Quantity	Percentage (%)
Normal	111	42.7
subchorionic fluid	149	57.3
Total	260	100

Comments: Among the patients with threatened miscarriage, 149 patients (accounting for 57.3%) were found to have subchorionic fluid through ultrasound. Among those with vaginal bleeding, 183 individuals (accounting for 70.3%) also showed subchorionic fluid on ultrasound.

Table 4. Treatment Outcomes by method of conception

Outcome	Natural Conception		IUI + IVF Conception		
	Quantity	Percentage (%)	Quantity	Percentage (%)	
Cured	182	86,3	43	87,8	p > 0,05
Failure	29	13,7	06	12,2	
Total	211	100	49	100	

The success rate in patients who conceived through IUI and IVF is 87.8%, while the success rate for natural conception is 86.3%. The difference in success rates between these conception methods is not statistically significant p > 0,05.

Table 5. Treatment Outcomes by the Presence of Subchorionic Fluid

Outcome	With subchorionic		Without subchorionic		
	Quantity	Percentage (%)	Quantity	Percentage (%)	
Cured	100	90,1	125	83,9	p > 0,05
Failure	11	9,9	24	16,1	
Total	111	100	149	100	

Comment: The success rate of treatment in patients with ultrasound findings of subchorionic fluid is 83.9%, while this rate is higher in patients without subchorionic fluid, reaching 90.1%. But it shows no statistically significant relationship between subchorionic fluid and treatment outcomes, with p > 0.05.

IV. DISCUSSION

Our study results show that the success rate of treatment in the group of mothers under 35 years old is 86.6%, while the rate in the group over 35 is slightly lower at 86.2%. This difference is not statistically significant (p > 0.05), indicating that maternal age is not a determining factor in treatment outcomes. This means that mothers over 35 do not necessarily face a higher risk in the treatment of threatened miscarriage.

The study by Trần Xuân Cảnh (2014) [5] also noted that age does not significantly affect the success rate in the treatment of threatened miscarriage. This suggests that, although age may be a risk factor in some cases, it is not the decisive factor for the success of treatment. This is further supported by the research of Lê Thị Anh Đào (2022) [1] which emphasizes that timely medical care and intervention play a much more critical role than the mother's age.

The advancement of modern medicine has provided many effective treatment methods for threatened miscarriage, allowing physicians to intervene early and proactively, regardless of the patient's age. Management and treatment of threatened miscarriage should be conducted in a coordinated and comprehensive manner, focusing on modifiable factors such as lifestyle, nutrition, and the psychological health of the mother.

The presence of subchorionic fluid is another factor studied in the context of threatened miscarriage. Results show that among 260 patients, 149 (57.3%) displayed signs of subchorionic fluid on ultrasound. The success rate of treatment in the group with fluid reached 90.1%, while in the group without fluid, it was 83.9%. Although there is a difference in success rates, there is no clear statistical relationship between subchorionic fluid and treatment outcomes ($p > 0.05$).

Soldo's study (2013) [3] indicated that subchorionic fluid may be associated with complications during pregnancy, but does not always lead to miscarriage. This suggests that while subchorionic fluid can be a warning factor, it is not a decisive factor for treatment success. Our study results indicate that patients with subchorionic fluid still have a high treatment success rate, opening new avenues for physicians in managing and treating threatened miscarriage.

Timely monitoring and intervention can help mitigate risks for the mother, regardless of the presence of fluid. This is crucial for establishing a comprehensive treatment plan for mothers, helping them feel more at ease during pregnancy. Additionally, psychological care and support play a significant role in improving treatment outcomes.

Besides maternal age and subchorionic fluid, other factors such as treatment methods also play an important role in enhancing success rates. According to our study results, the most common treatment method is the combination of tocolysis and hormones, accounting for 83.8% of all patients. This method shows high effectiveness in improving the condition of the mother.

Le Thi Huong's study (2014) [6] also demonstrated that early intervention and the use of appropriate treatment methods can significantly enhance the success rate in treating threatened miscarriage. This indicates that a professional and timely medical care approach can improve outcomes for mothers, regardless of other risk factors.

Furthermore, the research by Lê Thị Anh Đào and Nguyễn Viết Tiến (2015) [4] on the effectiveness of aspirin and heparin in treating recurrent miscarriage has shown that applying effective treatment methods can improve outcomes for mothers experiencing threatened miscarriage, even in the presence of other risk factors such as age or subchorionic fluid.

CONCLUSION

Maternal age does not have a significant impact on treatment outcomes, although it may be a risk factor. Similarly, the presence of subchorionic hematoma does not show a clear relationship with treatment outcomes. However, monitoring through ultrasound is still very important during treatment to improve patient outcomes.

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SURVEYING THE CORRELATION OF TEMPERATURE MEASURING BY NEW INFRARED METHOD AND RANGE OF MOTION OF JOINTS AFTER JOINT MOVEMENT EXERCISES

Nguyen Minh Hoai❖, Phan Minh Hoang[2❖], Che Quang Cong[3], Tran Tuan Hai[1], Nguyen Huu Duc Minh[1*]

ABSTRACT

Objective: The primary objective of this study was to investigate the connection between temperature variations and the range of motion (ROM) in the neck and shoulder regions following specific joint movements based on Traditional Medicine practices. To accomplish this, a novel infrared measurement method was employed to enhance the accuracy of assessments.

Method: The research was conducted at Ho Chi Minh City Hospital for Rehabilitation – Occupational Diseases over a period from April to July 2024. A total of 30 healthy participants, aged 18 and older, were recruited for the study, all of whom met established inclusion and exclusion criteria. To measure ROM and the temperature of acupoints in the neck and shoulder areas, an expert with over five years of relevant experience utilized a goniometer for assessing ROM and the advanced infrared method known as ATHERM for temperature measurement. The study specifically aimed to evaluate the changes in these parameters before and after the participants performed a series of joint movement exercises three times.

Results: The findings indicated a robust correlation between the observed temperature changes at the acupoints and improvements in ROM, which suggested that these exercises contributed to enhanced blood circulation and muscle function within the neck and shoulder regions.

Conclusion: This research underscores the significant relationship between temperature fluctuations at acupoints and improvements in ROM, particularly for the bilateral shoulder joints and cervical spine, following exercises rooted in Traditional Medicine.

Keywords: *Traditional Medicine neck joint movement exercises, Traditional Medicine shoulder joint movement exercises, new infrared method, neck and shoulder ROM, goniometer, skin temperature*

I. INTRODUCTION

Neck and shoulder pain is a widespread issue that impacts quality of life and work [1]. Causes include poor posture, prolonged mechanical stress, trauma, and musculoskeletal diseases [2]. With increased use of electronic devices, the risk of this pain is rising [3]. It often results from muscle tension, spine disorders, or nerve issues [4], highlighting the need for further research to improve treatment and reduce its negative impact on public health and productivity. [5].

In traditional medicine, joint movement exercises in massage help treat musculoskeletal issues by relieving pain, improving function, circulation, and mobility [16]. However, evidence on their effectiveness for treating neck and shoulder pain and enhancing circulation is limited.

Infrared methods for measuring skin temperature are emerging as a tool for diagnosing musculoskeletal diseases by assessing circulation and inflammation [6]. However, challenges with accuracy and reflecting physiological disorders remain [7], requiring further research to improve clinical use, early diagnosis, and treatment [8].

This study examines the effects of neck and shoulder exercises in healthy individuals by measuring changes in skin temperature, range of motion (ROM), and the correlation between thermal response and joint flexibility.

II. SUBJECTS AND METHODS

2.1. Subjects, locations and study period

Participants were recruited within the age groups of 18 years old or older, regardless of gender or occupation. Suitable participants must (1) be

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actively engaged in regular study, work, and daily activities; (2) possess full cognitive and behavioral capacity; and (3) provide voluntary consent before participation. Individuals who have (1) reported or complained of neck or shoulder pain in the previous month; (2) history of neck and shoulder disorders, including injuries and fractures, and a history of neurological and/or rheumatic disorders; (3) other significant medical histories are excluded from this study.

2.2. Research methods

A cross-sectional study of 30 individuals was conducted from April to July 2024 at Ho Chi Minh City Hospital for Rehabilitation – Occupational Diseases. The background variables include age and gender (Male/Female). The study variables are shoulder range of motion (Flexion, extension, abduction, adduction, internal rotation, external rotation), neck range of motion (Flexion, extension, right side bending, left side bending, right rotation, left rotation), skin temperature of acupuncture points in the shoulder region (unit: o C) (GB-21, LI-15, TB-14, SI-9, LU-2, LI-14), the neck region (unit: o C) (GB-20, GV-16, GV-14) and specific acupuncture points in the neck region (unit: o C) (LI-7, SI-3). Room temperature is 26oC.

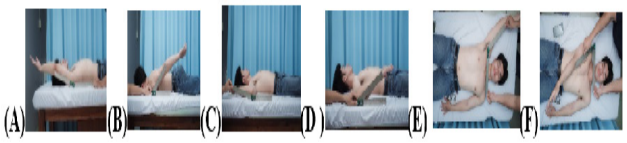

Figure 1. Shoulder ROM. (A) Flexion, (B) Extension, (C) External rotation, (D) Internal rotation, (E) Abduction, (F) Adduction

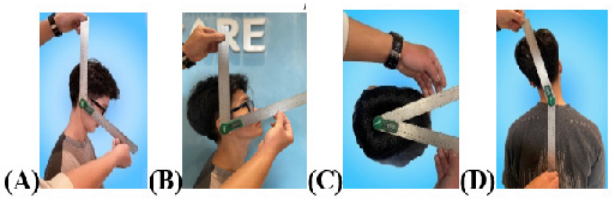

Figure 2. Neck ROM. (A) Flexion, (B) Extension; (C) Rotation, (D) Side bending.

- Measurement and data collection tools

A goniometer was used for measuring of joint range of motion has calibration certificate No. KT3-00481ADD4 dated April 11, 2024

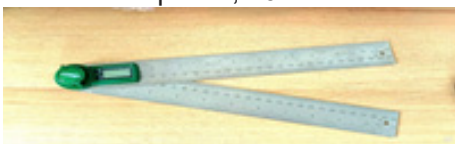

Figure 3. Goniometer

ATHERM infrared method No. 0057TN24/TĐC – TN has been standardized at the Ho Chi Minh City Quality Measurement Standards Technical Center on February 1, 2024 and accepted by BME10 Program Committee for publishing in IFBME Proceedings (Springer), indexed by Scopus.

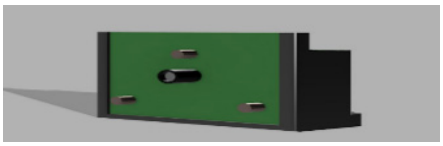

Figure 4. ATHERM infrared method

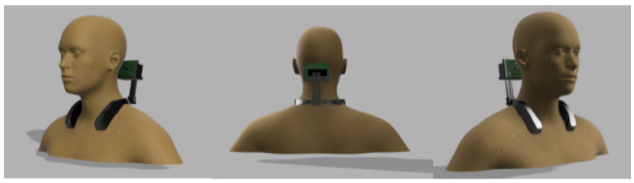

Figure 5. Design of the ATHERM machine

- Procedure

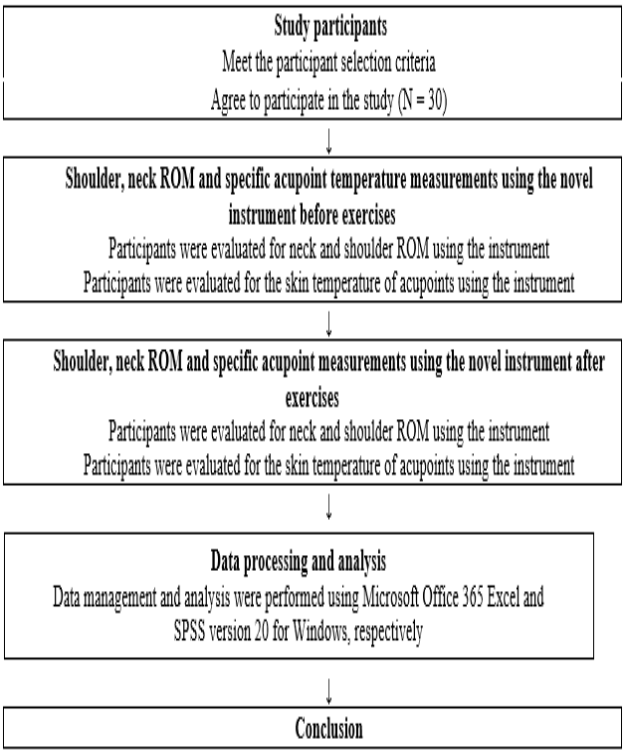

Figure 6. Procedure

- Joint movement exercises [16] :

Figure 7. Shoulder joint movement exercise. (A) Small rotation; (B) Wide rotation forward. (C) Shoulder stretch; (D) Wide rotation back

Figure 8. Neck joint movement exercise. (A) 360° rotation; (B) Extension; (C) Side bending.

2.3. Research ethics

This research project has received ethical approval from the Institutional Review Board (IRB) No. 287 of the University of Medicine and Pharmacy (UMP) on February 1, 2024, and was assigned the code 06/IRB - RVH - OHP on the same date at the Rehabilitation Hospital - Occupational Health Disease, Ho Chi Minh City. The study aims to solely evaluate and improve patient health, not for any other purpose. All participants voluntarily engaged in the study after receiving written consent and a thorough explanation of the study protocol. As any participants show signs of non-cooperation or request to stop participating in the study, the study will discontinue their involvement.

III. RESULT

The study surveyed 30 healthy volunteers who met the inclusion and exclusion criteria at Ho Chi Minh City Hospital for Rehabilitation - Occupational Diseases from Feb 2024 to May 2024:

Table 1. Assessment of shoulder range of motion and before and after shoulder joint movement exercise

ROM	Before exercise	After exercise
Mean ± Standard Deviation		
Flexion	164.74° ± 7.05	174.44° ± 5.74
	Δ= 9.7° ± 2.04	
	p < 0.001	
Extension	35.22° ± 3.98	39.93° ± 3.67
	Δ=4.7° ± 0.97	
	p < 0.001	
Abduction	166.5° ± 5.73	174.33° ±6.04
	Δ= 7.83°± 1.78	
	p < 0.001	
Adduction	36.48° ± 3.36	42.09° ± 3.66
	Δ= 5.61° ± 1.61	
	p < 0.001	
Internal rotation	76.35° ± 3.51	80.7° ± 4.14
	Δ= 4.35°± 1.87	
	p < 0.001	
External rotation	75.17° ± 3.40	79.74° ± 3.4
	Δ= 4.57°±0.85	
	p < 0.001	

According to Table 1, The shoulder ROM increased with a statistically significant change ($p < 0.05$), with an increase from 4.35° to 9.70°.

Table 2. Assessment of shoulder range of motion and before and after shoulder joint movement exercise

ROM	Before exercise	After exercise
Mean ± Standard Deviation		
Flexion	41.31° ± 6.72	46.71° ± 6.78
	Δ= 5.40° ± 1.08	
	p = 0.002	

ROM	Before exercise	After exercise
Extension	63.25° ± 7.93	68.43° ± 8.00
	Δ=5.18° ± 0.98	
	p = 0.014	
Left side bending	63.48 ° ± 2.55	73.75° ± 3.29
	Δ= 10.27° ± 3.05	
	p < 0.001	
Right side bending	69.47° ± 1.94	78.78° ± 2.56
	Δ=9.31° ± 1.96	
	p < 0.001	
Left rotation	43.14° ± 4.99	50.81° ± 5.15
	Δ= 7.67° ± 0.94	
	p < 0.001	
Right rotation	42.75° ± 4.80	50.35° ± 4.78
	Δ= 7.60° ± 0.9	
	p < 0.001	

Table 2 shows the neck ROM increased with a statistically significant change ($p < 0.05$), with an increase from 5.18° to 10.27°.

Table 3. Assessment of acupoints temperature on the shoulder before and after shoulder joint movement exercise

Temperature	Before exercise	After exercise
Mean ± Standard Deviation		
GB-21	34.44° C ± 1.27	36.61° C ± 1.47
	Δ= 2.17° C ± 0.37	
	p < 0.001	
LI-15	34.38° C ± 1.61	35.58° C ± 2.23
	Δ= 1.20° C ± 0.73	
	p = 0.02	
TB-14	34.55° C ± 1.74	37.64° C ± 2.09
	Δ= 3.10° C ± 0.46	
	p < 0.001	
SI-9	34.62 ° C ± 2.05	37.62° C ± 1.81
	Δ= 3.00° C ± 0.40	
	p < 0.001	
LU-2	34.48° C ± 1.83	37.67° C ± 2.36
	Δ= 3.18° C ± 0.68	
	p < 0.001	
LI-14	35.7° C ± 2.4	39.04° C ± 0.59
	Δ= 3.35° C ± 2.49	
	p < 0.001	

Table 3 indicates the temperature of acupuncture points in the shoulder area increased statistically significantly ($p < 0.05$), with an increase from 1.2°C to 3.35°C after joint exercise.

Table 4. Assessment of acupoints temperature on the neck before and after neck joint movement exercise

Temperature	Before exercise	After exercise
Mean ± Standard Deviation		
GB-20	35.64°C ± 2.06	36.55°C ± 2.02
	Δ= 1.13°C ± 0.87	
	p = 0.035	
GV-16	35.97°C ± 3.06	37.64°C ± 3.32
	Δ= 1.67°C ± 1.02	
	p = 0.048	
GV-14	35.8°C ± 2.53	37.57°C ± 2.55
	Δ= 1.77 ± 0.53	
	p < 0.001	

As Table 4, the neck temperature increased statistically significantly (p < 0.05), with an increase from 1.13°C to 1.77°C after exercising the neck and shoulder joints.

Table 5. Assessment of specific acupoints temperature for the neck before and after neck joint movement exercise

Temperature	**Before exercise**	**After exercise**
Mean ± Standard Deviation		
LI-7	35.88°C ±2.79	37.45°C ±2.91
	Δ=1.57°C ± 0.74	
	p = 0.038	
SI-3	35.71°C ± 2.29	37.58°C ± 2.28
	Δ= 1.87°C ± 0.46	
	p < 0.001	

Table 5 shows the temperatures of LI-7 and SI-3 acupuncture points both increased statistically significantly (p < 0.05), with an increase from 1.57°C to 1.87°C

Table 6. Correlation between changes of shoulder acupuncture point temperature and shoulder ROM

r/pearson	**Flexion**	**Extension**	**Abduction**	**Adduction**	**Internal rotation**	**External rotation**
GB-21	0.97	0.96	0.94	0.91	0.95	0.94
LI - 15	0.95	0.93	0.97	0.96	0.97	0.97
TB - 14	0.96	0.94	0.93	0.91	0.94	0.93
SI - 9	0.96	0.92	0.99	0.98	0.99	0.98
LU - 2	0.91	0.95	0.88	0.89	0.89	0.92
LI -14	0.97	0.96	0.96	0.94	0.97	0.95

Table 6 presents the correlation coefficients (r) between the changes in temperature at various shoulder acupuncture points and the range of motion (ROM) in different shoulder movements. The correlation coefficients range from 0.88 to 0.99 across the various measures, indicating a strong relationship between temperature changes and shoulder ROM.

Table 7. Correlation between changes of neck acupuncture point temperature and shoulder ROM

r/pearson	Flexion	Extension	Right side bending	Left side bending	Right rotation	Left rotation
GB - 20	0.85	0.87	0.88	0.90	0.94	0.91
GV - 16	0.89	0.91	0.91	0.93	0.96	0.94
GV - 14	0.89	0.90	0.91	0.93	0.96	0.94
LI - 7	0.88	0.90	0.90	0.91	0.95	0.93
SI - 3	0.90	0.91	0.92	0.95	0.98	0.96

Table 7 presents the correlation coefficients (r) between changes in temperature at various neck acupuncture points and the range of motion (ROM) in shoulder movements, including flexion, extension, side bending, and rotation. The results reveal a generally positive correlation between temperature changes at these acupuncture points and shoulder ROM across all measured movements.

IV. DISCUSSION

This study aimed to investigate the correlation between temperature and ROM of the neck and shoulder when practicing neck and shoulder joint movement exercise according to Traditional medicine using a new infrared method on healthy people, providing remarkable results in a better understanding of the effects of exercise on body temperature and ROM.

According to traditional medicine, the body's meridian system facilitates the circulation and movement of Qi (energy) and blood. The sinew meridians connect various joints and are primarily responsible for movement. The "knot" and "prosperity" points of the sinew meridians are located at the acupoints surrounding the joints. Therefore, we selected acupoints around the shoulder, including GB-21, LI-15, TB-14, SI-9, LU-2 and LI-14 to survey the temperature of the shoulder region. For the neck and nape area, we examined acupoints GB-20, GV-16 and GV-14 [16]. The acupoint LI-7 is significant for the neck and shoulders, while SI-3 is a crucial distal point related to pain, stiffness, and contracture along the meridian path and various cervical spine disorders [15].

In healthy individuals, restrictions in the range of motion (ROM) in the joints are often attributed to muscle tension caused by improper postures during daily activities or related pathologies. In such cases, skin temperature at the joints tends to be higher than that in other areas, indicating an inflammatory response that may be associated with the tension and discomfort in the muscles surrounding the joints [10,11].

Joint movement exercise is one of the massage techniques and a non-pharmacological method in traditional medicine. Joint movement exercise supports the muscle pump mechanism, aiding venous blood return to the heart. The contraction and relaxation of muscles during passive movement create a pumping action, facilitating venous blood return and increasing circulation [12]. The release of chemicals such as nitric oxide, prostaglandins, and adenosine leads to vasodilation, enhancing blood flow to the tissues [13]. The dilation of superficial skin blood vessels helps increase thermal dissipation from the body into the surrounding environment. This contributes to the perception of warmth on the skin surface, measured by the increase in temperature in our study [14].

The results indicate a significant correlation between body skin temperature and the ROM in the neck and shoulders. After joint movement exercises, the ROM for both the neck and shoulder joints increased. For shoulder ROM, the flexion movement showed the most significant increase with a mean rise of 9.70° (±2.04), while the internal rotation movement had the lowest increase with a mean of 4.35° (±1.87). In terms of neck ROM, left rotation exhibited the highest increase with a mean rise of 10.27° (±3.05), while the extension movement had the lowest with a mean of 5.18° (±0.98). LI-14 is the intersection point of the two meridians Hand Yang Ming Large Intestine and Foot Yang Ming Stomach, which is a meridian with much Qi and much blood. The temperature of LI-14 is highest before (35.70^{o}C ± 2.40) and after exercise (39.04^{o}C ± 0.59) which is evidence that

this is a meridian with much Qi and much blood in traditional medicine.

The infrared method we used has proven to be an accurate tool for measuring surface temperature on the body. Results from this method show high consistency and reliability in identifying temperature changes after joint movement exercises [17]. The infrared method also provides continuous, non-invasive observation capabilities, allowing for the tracking of temperature changes over time during exercise.

V. CONCLUSION

This study reveals a strong correlation between increased skin temperature at neck and shoulder acupoints and improved range of motion (ROM) after joint exercises based on traditional medicine. The rise in temperature is linked to better circulation and muscle function. Infrared measurement proved accurate in assessing temperature changes, highlighting its potential for clinical use. Further research with larger, diverse samples is needed to confirm these findings and apply them to broader populations. This could lead to personalized exercise programs and better management of neck and shoulder pain, enhancing patient care and recovery.

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EVALUATION OF OUTCOMES OF LUMBAR INTERBODY FUSION FOR L4-L5 SPONDYLOLISTHESIS AT THAI BINH GENERAL HOSPITAL

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ABSTRACT

Objective: To evaluate the outcomes of lumbar interbody fusion surgery for L4-L5 spondylolisthesis at Thai Binh general hospital from January 2022 to January 2024.

Method: A retrospective cross-sectional study was conducted among 68 patients suffered from L4 - L5 lumbar spondylolisthesis and had operated at the Neurospine Surgery Department in Thai Binh general hospital.

Results: The median age of patients undergone lumbar interbody fusion was 49,5 ± 10 (years old). Gender ratio was 3 females per 1 male, the duration of disease detection was 38±18 (months). Postoperative outcomes verified that lumbar interbody fusion was the safe and effective surgery with short operation duration (123,9 ±13,2 minutes), 5,9% of intraoperative adverse incidents, 25% of short-term postoperative complications, 5,8% of long-term complications of the surgery. Good and satisfactory outcomes achieved 86 8% without any poor outcomes based on Macnab criteria.

Conclusion: lumbar interbody fusion for L4-L5 spondylolisthesis is a safe and highly effective surgery.

Keywords: *lumbar spondylolisthesis,lumbar interbody fusion, pedicle screw, interbody cage.*

I. INTRODUCTION

Spondylolisthesis is the displacement of the upper vertebrae to lower one. There are many causes, but the main causes were spondylosis and spondylolysis [1]. In addition, lumbar spondylolisthesis can also be caused by congenital abnomalities, trauma or tumors. Most patients with lumbar spondylolisthesis have a silent progression without symptoms. When going to the hospital for examination, patients often suffered from symptoms of nerve compression, lumbar spine pain due to instability, and in the late stages, it can even cause more severe nerve lesions such as paralysis, changes in posture of the lumbar spine and affect gait [2].

Researches in Vietnam demonstrate that spondylolisthesis usually occurs in the lumbar (low back) spine, more commonly at L4-L5 (4th and 5th lumbar vertebral levels) [3-7].

Lumbar interbody fusion surgery is indicated after nonoperative treatment and rehabilitation are ineffective for the purpose of nerve root decompression and vertebral fusion. There are many surgical methods applied and intensively studied by many reseachers. Several forein reseachers have assessed outcomes of lumbar interbody fusion for L4-L5 spondylolisthesis. There are only a few reseaches in Vietnam into this subject, especially at provincial hospitals. Therefore, we conducted this study to aim at evaluating the outcomes of lumbar interbody fusion for L4-L5 spondylolisthesis at Thai Binh general hospital from January 2022 to January 2024.

II. SUBJECTS AND METHODS

2.1. Subjects

68 patients diagnosed with L4-L5 spondylolisthesis and undergone lumbar interbody fusion surgery at Thai Binh general hospital from January 2022 to January 2024.

2.2. Methods:

Type of reseach: retrospective cross-sectional study

Patient list was created from medical records of Neurospine Surgery Department (clinical and radiographic manifestations) before, during and after treatment

Contact to patients for re-examination (by by phone and mail). Patients were re-examined with postoperative radiographs archived were received questionnaire for data collection. Patients who could not be contacted were removed from the list.

2.3. Data processing:

Data coding, entry, and analysis were conducted using SPSS version 22.0. Descriptive statistical methods were employed to characterize the dataset, including the calculation of frequencies, percentages, and mean values. Comparative analyses between groups were performed using

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appropriate statistical tests: ANOVA for the comparison of two or more mean values and the χ^2 test for the comparison of proportions. Statistical significance was defined as $p < 0.05$.

2.4. Research ethics

All participants in this study were provided with comprehensive information regarding the research objectives, significance, and methodology. They subsequently provided explicit written consent to participate. Participants retained the right to withdraw from the study at any time without facing any repercussions. All collected data were utilized exclusively for research purposes, and the confidentiality and anonymity of participant information were rigorously maintained through secure encryption protocols. This study was conducted and presented to the council in accordance with Decision No. 1703 dated September 20, 2024, issued by Thai Binh University of Medicine and Pharmacy.

III. RESULTS

Age and gender characteristics: The median age of patients in the study was 49.5 ± 10.1 years old with the lowest being 28 years old and the highest being 73 years old. The most common age group in the study was from 50 to 59 years old with 24 patients accounting for 35.3%. Including both groups, the most common age group was from 40 to 59 years old with a total of 44 patients, forming 64.7%. L4-L5 spondylolisthesis mainly occurs females with a female/male ratio of approximately 3/1.

Table 1. Duration of disease detection (n = 68)

Duration of disease detection	Cases	Rate
Under 6 months	15	22,1%
6 - 12 months	27	30,9%
Over 12 months	26	47%

Most patients admitted had symptoms onset for more than 1 year (47.0%), the average time was 38 ± 18 months, the shortest was 2 months, the longest was 62 months.

Tablet 2. Intraoperative adverse incidents (n = 68)

Incidents	Cases	Rate (%)
Dural tears	2	2,9
Nerve root injuries	1	1,5
Broken pedicles	1	1,5

In our study, there were 2 cases of dural tear, 1 case of L5 root injury during surgery, and 1 case of broken pedicle encountered in the course of surgery.

Tablet 3. Short-term postoperative complications (n = 68)

Complications	Cases	Rate (%)
Blood transfusions	11	16,2
Urinary retentions	2	2,9
Surgical site infections	3	4,4
Length of hospital stay	6,5 ± 2,6 (4-13)	

Short-term postoperative complications: 11 patients required blood transfusion, accounting for 16.2%. 02 patients had urinary retention requiring catheter placement. 03 patients had surgical site infection. There was no implant failure.

Tablet 4: Comparison of functional symptoms before and after surgery (n = 68)

Symptom assessment	Preoperative VAS	Long-term postoperative VAS
Low back pain	5,6 ± 1,6	1,7 ± 0,8
Radicular pain	5,3 ± 2,3	0,9 ± 0,7

Before the surgery, low back pain VAS (Visual Analogue Scale) of the patients was 5,6 ± 1,6 points, radicular pain VAS was 5,3 ± 2,3 points. These functional symptoms were significantly improved with low back pain VAS of 1,7 ± 0,8 points and radicular pain VAS of 0,9 ± 0,7 points at last examinations.

Tablet 5. Long-term complications (n = 68)

Long-term complications	Cases	Rate (%)
Cage displacements	2	2,9
Progressive spondylolisthesis	2	2,9

There were 2 patients suffered from cage displacements and 2 of progressive spondylolisthesis in the period of our research

Table 6. Outcomes according to Macnab criteria (n = 68)

Macnab criteria	Cases	Rate (%)
Good	36	51,5
Satisfactory	24	35,3
Moderate	9	13,2

35/68 patients (51.5%) had good outcomes, 24/68 patients (35.3%) satisfactory outcomes, 9/68 patients (13.2%) had moderate outcomes, no poor outcomes.

IV. DISCUSSION

In the 68 patients studied, the median age was 49.5 ± 10 years old (from 28-73). The most common age group was 40 - 59 years old with a total of 44 patients, accounting for 64.7%, this data is consistent with the research results of Kim K.R [8] at 52,5 years old of median age. Our study found that the female rate was 3 times higher than that of male, with the female and male rates being 72.5% and 26.5% respectively. This result was consistent with Nguyen Vu's research of approximately 3% [3]. However, according to Yingsakmongkol W's research, the males were dominant, accounting for 81%. In our opinion, the higher rate of female patients with lumbar spondylolisthesis may be due to the fact that our country's economy is still developing, so the number of women who have to do heavy labor is approximately equal to that of men. In addition, some studies have also shown that spondylolisthesis in women is often more painful and tends to progress more than in men [10].

Most patients were hospitalized when they had symptoms for more than 1 year (47.0%), the average time was 38 ± 18 months (2 - 62 months). The research results of some domestic authors were 14.8 months and foreign authors were 18.6 months [3;7] also demonstrated that patients came to the hospital for treatment late from the time symptoms were detected. The fact that patients came to the hospital for treatment late often had a negative impact on their treatment outcomes and recovery.

In our research, the average operative time was 123.9 ± 13.2 minutes. Kim K.R's research had a average operative time of 130 minutes [8]. This is explained by the fact that our patient group had low slippage, modern surgical equipment was used, thus operative time in our reseach was shorter. 100% of patients did not require blood transfusion during surgery.

There were 4/68 cases of intraoperative adverse incidents made of 5.9%, including 2 cases of dural tears, 1 case of nerve root injury and 1 case of broken vertebral pedicle. The first 2 patients had dural repair, they had good progress after treatment. There was 01 patient with nerve root injury during the surgery due to a broken pedicle in the process of screwing, the impact of the screw caused the root to be constused and swollen. In the studied patients, there were no cases of major vascular injury during surgery. Some studies by other domestic authors also studied this topic such as Nguyen Vu, Kieu Dinh Hung, there were no patients with intraoperative adverse incidents [3, 5]. Le Duy Tram's research [7] mentioned 04 patients with intraoperative nerve root injuries. In Kim YH, Ha KY.'s research [10], there were 02 cases of intraoperative nerve root injuries due to anatomical abnormalities of neural foramina.

Short-term postoperative complications: 11 patients (16.2%) required blood transfusion short after surgery. The patient with nerve root injury was gradually recovering by medications. We noted that although no patient required blood transfusion during surgery, 11 patients required additional blood transfusion short after surgery. We believe that most of the patients in the research group were elderly, and after surgery, the amount of blood in the body was not able to recover, so blood transfusion was necessary. There were 2 patients with bladder sphincter dyssynergia who

had to catheterize. After 2 days, the catheter was removed and they were able to urinate on their own, which could be explained by complications of anesthesia. There were 3 patients endured superficial surgical site infections who had to have the wound dressing changed and vacuum-assisted closure performed. Average length of hospital stay was 6.5 ± 2.6 days, with a minimum of 04 days and a maximum of 13 days.

Before surgery, VAS of low back pain was 5.6 ± 1.6 points, VAS of radicular pain was 5.3 ± 2.3 points. After evaluating the long-term outcomes, VAS of low back pain was 1.7 ± 0.8, VAS of radicular pain was 0.9 ± 0.7. Compared with preoperative and short-term postoperative symptoms, this difference was statistically significant. Hoang Gia Du's study [4] evaluated the long-term outcomes after showed that the improvement was not much, in our opinion, it may be because the average follow-up time in the author's study was only 6 months. It can be affirmed that the level of low back pain and radicular pain of the patient has improved significantly in the long-term.

In our study, there were 02 patients with cage displacement and Progressive spondylolisthesis in the long-term after surgery. These 02 patients were advised on how to exercise, live and wear a brace. Nguyen Vu's study [3] had 01 patient with a hardware loosening after 09 months and had to be re-operated and 05 patients with hardware breakage but had no clinical manifestations so they did not have surgery.

Overall assessment of surgical outcomes based on Macnab criteria: 35/68 patients (51.5%) had good outcomes, 24/68 patients (35.3%) had satisfactory outcomes, 9/68 patients (13.2%) had moderate outcomes. These outcomes are consistent with the outcomes in research of Yingsakmongkol W [9] with 11/27 patients (40.7%) having good outcomes, 16/27 patients having satisfactory and moderate outcomes.

V. CONCLUSION

Lumbar interbody fusion for L4-L5 spondylolisthesis is a safe and highly effective surgery.

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KNOWLEDGE AND PRACTICE OF USING ANTIBIOTICS AMONG MOTHERS OF CHILDREN UNDER 2 YEARS OLD WITH DIARRHEA LIVING IN 3 WARDS IN THAI BINH CITY IN 2023

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Abstract

Objective: This study aims to describe the knowledge and practice of using antibiotics among women with children under 2 years old living in 3 wards in Thai Binh city in 2023.

Method: An epidemiological study with a cross-sectional survey was conducted on 380 mothers of children under 2 years old living in 3 wards in Thai Binh in 2023. The descriptive analysis was used to describe the knowledge and practice of using antibiotics among study participants.

Results: This study was conducted on 380 study participants. Of these, 86.3% had heard of antibiotics, and 61.6% used antibiotics to treat their children's diarrhea. The proportion of participants who met the knowledge standard and were aware of important medical guidelines when using antibiotics was 40.5% and 80.5%, respectively. Additionally, 35.9% of study participants demonstrated good practices in using antibiotics.

Conclusion: This study contributes to the ongoing conversation about antibiotic stewardship and the need for better public health initiatives to promote proper medication use, ultimately improving health outcomes and combating the threat of antibiotic resistance.

Keywords: *mother. children under 2 years old, diarrhea, antibiotics, knowledge, practice.*

I. INTRODUCTION

Diarrhea is a common medical condition among children in preschool age and early elementary school years. According to the World Health Organization (WHO), diarrhea is the second leading cause of death in children under 5 years old. This causes the death of more than 500,000 children each year. Diarrhea causes dehydration, and electrolyte loss is dangerous for children. Previously, this condition was the main cause of death due to diarrhea. However, nowadays, deaths from other causes such as bacterial infections are on the rise. Children who are malnourished or immunocompromised are at the highest risk of life-threatening diarrhea [1].

The mortality rate due to infections in children with diarrhea is increasing, partly because antibiotic resistance is becoming more common. Antibiotic resistance has risen to dangerous levels all over the world. New drug resistance mechanisms are emerging and gradually spreading globally, threatening the ability to treat infectious diseases, including common ones. Diarrhea in children due to antibiotic use is increasingly common. Therefore, there is a need to enhance mothers' knowledge and practice of using antibiotics. However, in Vietnam, there are not many studies evaluating mothers' knowledge and practices on antibiotic use. Therefore, we conducted a study entitled "Describe the knowledge and practice of using antibiotics among mothers of children under 2 years old with diarrhea living in 3 wards in Thai Binh city in 2023". This study aims to describe the knowledge and practice of using antibiotics among women with children under 2 years old living in 3 wards in Thai Binh city in 2023.

II. SUBJECTS AND METHODS

2.1. Subjects, locations, and study period

*Target population:

Mothers of children aged under 2 years old had diarrhea.

Inclusive criteria: Individuals who met the below criteria were included in the study.

+ Mothers of children under 2 years old who had diarrhea within 1 year up to the baseline of the study;

+ Mothers lived in the study location at the time of the study;

+ Mothers who agreed and voluntarily participated in the study.

Exclusive criteria:

1.Thai Binh University of Medicine and Pharmacy

2. Thai Binh Hospital

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+ Mothers who could not answer the questions and/or did not agree to participate were excluded from the study.

***Study location:** 3 wards in Thai Binh city, including Quang Trung ward, Ky Ba ward, and Tran Lam ward.

***Study period:** from December 2022 to July 2023.

2.2. Method

***Study design:** An epidemiological cross-sectional study.

***Sample size:** This study used the formula below to calculate the sample size:

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

With:

n: sample size;

α: level of statistical significance (this study used α = 0.05)

$Z_{(1-\alpha/2)}$: with α = 0.05, Z = 1.96;

d: desired degree of precision (this study chose d = 0.05)

p: p = 0.443 is the percentage of mothers of children under 2 years old who knew how to use antibiotics [2].

The sample size = 380.

*Sampling:

- Purposefully selected 3 wards in Thai Binh city to conduct the study including: Quang Trung ward, Ky Ba ward, and Tran Lam ward.

A systematic sampling method was applied to this study. First, we made a list of all mothers of children under 2 years old with diarrhea within 1 year before the time of the study. After that, we divided the total number of mothers in the list by the sample size of 380 to get the distance coefficient "k". The study sample size was 380, so 127 study participants needed to be interviewed in each ward. We randomly selected the first study participant from the list of all mothers of children under 2 years old in each ward using the random drawing method. Then, we determined the next study participant by adding the serial number of the previous participant with the distance coefficient "k" until there was a sufficient sample size.

Study variables and indicators:

+ Variables on demographic characteristics of study participants: age, sex, education level, occupation, …

+ Variables on knowledge of antibiotics use among study participants: knowledge of when to use antibiotics, the proper duration of use, etc.

+ Variables on practice of using antibiotics among study participants: time of use, adherence to instructions while using antibiotics, management of side effects during antibiotic use, etc.

+ Indicators: the proportion of study participants with satisfactory knowledge of antibiotics and the proportion of study participants with good practice in using antibiotics.

*** Data collection method:**

- The questionnaire was developed based on references and expert opinions in the field of public health to align the study objectives. A pilot survey was conducted to refine and finalize the questionnaire before this study began.

- Staff involved in the study received thorough training on the study objectives and data collection methods.

- Study participants were fully informed about the objectives and content of the study. Interviews were conducted only after participants agreed to participate in the study. If the study participant was not at home, the interviewer would schedule an appointment to return and conduct the interview with the participant. If the interviewer was unable to meet the participant after a third attempt, the participant was removed from the study sample.

*** Data processing method:**

- Questions on knowledge of antibiotic use were numbered from question 8 to question 18. Each correct answer was worth 1 point, and the maximum possible score was 19 points. Participants who answered at least 70% of the questions correctly (equivalent to 13 points or more) were considered to have good knowledge.

- Questions on antibiotic use practices included 13 single-choice and multiple-choice questions. Each correct answer was worth 1 point, and the maximum possible score was 16 points. Those who answered at least 70% of the questions correctly (equivalent to 11 points or more) were considered to have good practice

- Data was managed and cleaned using Epidata 3.1 software. Statistical tests were performed using

SPSS 22.0 software. In this study, quantitative variables were described as mean values and standard deviations; qualitative variables were described as numbers and percentages (%).

2.3. Study ethics

- The study was approved through the outline review board of Thai Binh University of Medicine and Pharmacy in Decision No. 55 dated January 10, 2023 and was permitted by the authorities in the study area.

- Study ensures the right to "voluntary participation" of study participants. Interview information is used for study purposes only. The results and suggestions are used to improve and strengthen community health care.

III. Results

Table 1. Demographic characteristics of study participants (n = 380)

		n	%
Age group	<30	86	22.6
	30-39	186	49.0
	40-42	108	28.4
Education level	High school	27	7.1
	College/University or higher	353	92.9
Occupation	Worker	135	35.5
	Officials/Civil servants	29	7.6
	Housewife	84	22.1
	Self – employed	14	3.7
	Farmer	118	31.1
Number of children	1	144	37.9
	2	227	59.7
	≥3	9	2.4
Family members working in the medical/pharmacy field	No	209	45.0
	Yes	171	55.0
Family economic conditions	Near poor	5	1.3
	Average	370	97.4
	Rich	5	1.3

Table 1 shows that the study population was predominantly in the 30-39-year-old age group (49.0%), while the group under 30 years old had the lowest percentage (22.6%). A significant majority of the mothers interviewed (93.0%) gad an education level at least secondary school. The most common occupations among participants were workers and farmers, comprising 35.5% and 31.1% of the study sample, respectively. Only 3.7% of participants were self-employed. In terms of family size, 60.0% of the mothers had 2 children, and 55.0% had family members working in the medical or pharmaceutical industry. 97.4% of study participants reported average economic conditions.

Table 2: Proportion of study participants who have ever heard information about antibiotics and sources of information

Information about antibiotics		n	%
Never heard		52	13.7
Ever heard		328	86.3
Source of information	Doctors	317	83.4
	Pharmacists	285	75.0
	Friends	230	60.5
	Internet, TV, radio	204	53.7

Table 2 shows that the majority of mothers interviewed had heard information about antibiotics (86.3%). Among different sources of information, doctors were the most common (83.4%), followed by pharmacists (75.0%). Additionally, approximately 54.0% of study participants reported accessing information about antibiotics through the Internet, TV, or radio.

Table 3: Study participants' knowledge about precautions when using antibiotics

Knowledge	n	%
Must see a doctor	289	76.1
Only use with doctor's prescription	306	80.5
Use medication as prescription	323	85.0
Check medicine before using	316	83.2
Monitor reactions after taking medicine	214	56.3

Table 3 shows that more than 50.0% of the study participants correctly understood the precautions for using antibiotics. Among them, 85.0% believed it was necessary to use medicine as directed by healthcare professionals, and 83.2% agreed that it was important to check the medicine before use. Additionally, 56.3% of the mothers interviewed knew they should monitor for children's reactions after taking the medicine.

Table 4: The rate of using antibiotics among study participants at the latest time their children had diarrhea

Practice		n	%
Using antibiotics	No	146	38.4
	Yes	234	61.6
Time of using antibiotics	1-4 days	78	33.3
	5-7 days	119	50.9
	8-10 days	37	15.8
Instructors	Doctors	96	41.0
	Pharmacist	72	30.8
	Self-teaching	71	30.3
Adjust the dose themselves	No	136	58.1
	Yes	98	41.9

As shown in the results, 61.6% of study participants used antibiotics during their child's most recent episode of diarrhea. Over half of the mothers administered antibiotics for 5-7 days, while the proportion of mothers who used antibiotics for more than 7 days was the lowest, at 15.8%. Additionally, 42.0% of participants adjusted the antibiotic dose themselves. Among the mothers who used antibiotics to treat their children's diarrhea, the highest proportion (41.0%) followed the doctor's instructions. The proportions of participants using antibiotics according to the pharmacist's instructions or based on self-guidance were similar, at 30.8% and 30.3%, respectively.

Table 5: The rate of children who experienced side effects of antibiotics and how their mothers managed

		n	%
Got side-effects	No	225	97.6
	Yes	9	2.4
How to deal with the side-effects	Self-monitoring within 24 hours	2	22.2
	Went to meet the doctors	5	55.6
	Others	2	22.2

Of the 234 children who were given antibiotics during their most recent episode of diarrhea, 2.4% experienced side effects. Among the mothers whose children experienced side effects, 55.6% sought medical attention, while 2.2% chose to self-monitor their child's condition within 24 hours.

Table 6: General knowledge and practice of using antibiotics among study participants

		n	%
Knowledge of antibiotic use	Good	154	40.5
	Poor	226	59.5
Antibitotic use practices	Good	84	35.9
	Poor	150	64.1

Table 6 shows that two-fifths of the study participants had good knowledge of using antibiotics for children with diarrhea. The results also revealed that the proportion of participants who did not follow proper antibiotic use for children was 1.5 times higher than those with good practice (64.1% and 35.9%, respectively).

IV. DISCUSSION

This epidemiological study, conducted through a cross-sectional survey, involved 380 mothers with children under 2 years old who had diarrhea, across 3 wards in Thai Binh city in 2023. Of these participants, 49.0% were aged between 30 and 39 years. A significant majority (93.0%) of the mothers had at least a secondary school. These findings are higher than those reported by Hoang Thi Hai Van, whose study found that only 30.6% of participants had an education level above high school [2]. The most common occupations among the participants were workers and farmers, accounting for 35.5% and 31.1%, respectively. Three-fifths of the mothers interviewed had two children, and slightly more than half had family members working in the medical and pharmaceutical industries. The majority (97.4%) of participants reported having average economic conditions.

Table 2 shows that 86.3% of interviewed mothers had heard information about antibiotics. Additionally, 83.4% of study participants often sought knowledge about antibiotics from healthcare professionals, including doctors and nurses, while more than one-half of the participants referred to information from media sources such as the Internet, television, and radio. Despite regulations on prescribing and selling prescription drugs, patients can still purchase antibiotics and many other medications directly from pharmacies and retail outlets. Self-treatment is common, though self-diagnosis is often inaccurate.

Our study found that 80.5% of participants used antibiotics with a prescription from a doctor. These results are similar to those from a study conducted in Tamale, Ghana, where 44.1% of households reported using at least one antibiotic in the past month, and 30.9% used antibiotics without a prescription [3]. A 2007 community-based study also found that nearly 80.0% of antibiotics were purchased from private pharmacies without a prescription. Buying medicine directly is often seen as a way to save both money and time compared to visiting a doctor [4]. However, according to Ho Tat Phuong Uyen, 78.0% of people who purchase antibiotics still require a prescription. This could be viewed as a positive step toward limiting antibiotic resistance in the community [5]. On the other hand, more than 80.0% of people engage in self-medication for themselves or their relatives, with 51.4% using antibiotics without proper guidance [6].

The study found that 61.6% of the interviewed mothers used antibiotics during their child's most recent treatment for diarrhea. The rate is higher than the 37.2% reported in Nguyen Van Thien's study at Tay Ninh General Hospital in 2020 [7]. In our study, the duration of antibiotic treatment for diarrhea varied: 50.9% of cases involved treatment lasting less than 5 days, 33.3% lasted 5-7 days, and nearly 16.0% lasted more than 7 days. When asked about the correct duration for antibiotic treatment, half of the participants form Hoa Hai ward in Da Nang city indicated that treatment should last between 3 to 5 days. Only 3.1% of participants selected 7-10 days as the appropriate treatment duration [5]. A study conducted in Ha Nam province found that 54.3% of mothers had a good general knowledge of antibiotic use, and 37.9% knew the correct duration for antibiotic treatment [2]. Furthermore, 41.9% of study participants used antibiotics for their children during the most recent treatment for diarrhea and also self-adjusted the antibiotic dose during treatment. This is lower than the 62.7% observed in a study by Hoang Thi Hai Van, where participants reported arbitrarily adjusting the antibiotic dose, typically stopping the medication once the child's symptoms improved [2].

The rate of children experiencing unwanted effects when using antibiotics was 2.4%. Among children who experienced side effects, 77.8% of mothers who used antibiotics to treat their children for the most recent episode of diarrhea knew it was necessary to either take their children to see a doctor or monitor them for the next 24 hours.

Table 6 shows that 40.5% of study participants had good knowledge about using antibiotics, while 59.5% had poor knowledge. Our findings are consistent with those of Tran Thi Mai Hung's study conducted in some regions of Vietnam in 2018-2019, which reported that 39.0% of participants had good knowledge about antibiotic use [8]. Similarly, a 2007 study assessing knowledge of antibiotic use in rural areas of Vietnam found that, despite the existence of guidance documents, knowledge about antibiotics remained limited, and healthcare providers often prescribed antibiotics unnecessarily for common colds. Additionally, the type, dose, and duration of treatment frequently did not adhere to prescribed guidelines [7].

Table 6 also shows that 35.9% of study participants had good practices regarding antibiotic use, while 64.1% had poor practices. Our study results are higher than those of Tran Thi Mai Hung's study, where only 16.7% of participants had good practices in antibiotic use. When a family has a child with acute diarrhea, caregivers need to have adequate knowledge and practices [8]. A study of 94 mothers at the gastroenterology department of Nghe An Obstetrics and Pediatrics Hospital found that 56.4% of mothers did not follow proper dietary practices for their children's acute diarrhea. Furthermore, 39.4% of mothers failed to mix Oresol correctly, and only 33.0% administered Oresol as instructed by the doctor [9]. A study at Hai Phong Hospital also revealed that 70.9% of mothers practiced proper care, with 79.1% correctly using Oresol, 55.7% following the right nutritional guidelines, and 88.4% washing their hands with soap before feeding their children [10].

The study offers valuable insights into the knowledge and practices among mothers related to antibiotic use for children with diarrhea. One key advantage of our study is its ability to compare its findings with similar studies, such as Tran Thi Mai Hung's study in Vietnam, providing context and relevance to the results. Our study results also demonstrate a significant portion of the population with poor knowledge and practices of antibiotic use, including self-adjustment of antibiotic doses and adherence to medical instructions. These findings can further contribute to the growing body of evidence regarding antibiotic stewardship. However, there are several limitations to consider. First, the study's reliance on self-reported information may cause biases, as participants could overestimate their knowledge and practices. Additionally, the cross-sectional design limits the ability to establish causal relationships between knowledge and practices among study participants.

V. CONCLUSION

The study was conducted on 380 mothers with children under 2 years old who had diarrhea in 3 wards of Thai Binh city in 2023. Study results showed that 40.5% of study participants had good knowledge of using antibiotics. 86.3% of mothers participating in the study had heard about antibiotics with doctors and pharmacists being the two most common sources of information (83.4% and 75.0% respectively). Besides, 85.0% of the study participants understood the need to use medication exactly as prescribed by the doctors. Our study findings emphasize the importance of improving educational efforts to ensure that caregivers, especially mothers, are better informed about the correct use of antibiotics and other treatments for diarrhea.

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STUDY ON THE ANTIBIOTIC SUSCEPTIBILITY OF PATHOGENS CAUSING HOSPITAL-ACQUIRED PNEUMONIA IN THE INTENSIVE CARE UNITS OF QUANG NGAI GENERAL HOSPITAL

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ABSTRACT

Objective: This study aimed to describe the antibiotic resistance patterns of bacterial pathogens causing hospital-acquired pneumonia (HAP) in the intensive care unit (ICU) at Quang Ngai Provincial General Hospital.

Method: An observational study was conducted using medical records of 68 HAP patients admitted to the ICU between January 2023 and April 2024. Data were collected on patient characteristics, microbiological test results, and bacterial antibiotic susceptibility. The susceptibility of bacterial strains to Beta-lactams, Aminoglycosides, Fluoroquinolones, and Glycopeptides was analyzed using SPSS 27.0.

Results: The mean age of patients was 77.38 ± 13.37 years, with 52.9% aged ≥80. The average hospital stay was 28.76 ± 18.28 days. Among 64 microbiological specimens, sputum accounted for 89.1%, isolating 57 bacterial strains. The predominant pathogens were *Acinetobacter baumannii* (24.6%), *Klebsiella pneumoniae* (22.8%), and *Escherichia coli* (17.5%). Antibiotic susceptibility testing revealed that most pathogens exhibited high resistance to Beta-lactams. *A. baumannii* showed resistance to all Beta-lactams except imipenem/cilastatin (1/14 strains). *E. coli* demonstrated limited sensitivity to ceftazidime (3/10 strains) and meropenem (3/10 strains). *K. pneumoniae* and *Pseudomonas aeruginosa* retained moderate sensitivity to carbapenems, while *Proteus mirabilis* exhibited low sensitivity to imipenem/cilastatin and meropenem.

Conclusion: The findings highlight the severe antibiotic resistance among HAP pathogens in the ICU, emphasizing the critical need for regular surveillance and updated antibiotic stewardship programs to optimize treatment and improve outcomes.

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I. INTRODUCTION

Hospital-acquired pneumonia (HAP), including both hospital-acquired pneumonia and ventilator-associated pneumonia (VAP), is a leading cause of significant increases in treatment costs as well as burdens on the healthcare system and patients [1]. Despite advances in diagnosis and treatment, mortality rates from hospital-acquired pneumonia remain high [2]. According to various studies, the mortality rate for HAP and VAP ranges from 20% to 25%, but can rise to as high as 70% when patients are infected with multidrug-resistant bacteria [3]. It is estimated that in the United States during the period of 2010-2012, VAP increased the duration of mechanical ventilation from 7.6 to 11.5 days, extended hospital stays from 11.5 to 13.1 days, and added an average of approximately $40,000 in treatment costs per patient [4].

Recent studies in Intensive Care Units (ICU) of hospitals in Vietnam show that the primary agents causing HAP are mainly Gram-negative bacteria, with *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae* being the most common [5]. These bacteria exhibit high antibiotic resistance rates against most available antibiotics. The choice of a rational antibiotic regimen is crucial for determining treatment efficacy. In the treatment of HAP, antibiotics need to be prescribed as early as possible. However, the patterns of bacterial antibiotic resistance vary by region, hospital, department, and physician antibiotic use habits. Therefore, each hospital has its own antibiotic resistance patterns. Particularly in ICU, the issue of antibiotic resistance becomes even more complex [6].

Quang Ngai Provincial General Hospital, a Grade I provincial hospital, provides care and treatment for local residents. The number of infection cases, including HAP, is increasing, and the situation of antibiotic resistance is becoming more complicated, especially in the ICU. However, to date, no studies

have described the antibiotic resistance situation in HAP patients at this hospital.

With the aim of describing the antibiotic resistance patterns of bacteria in HAP patients in the ICU at Quang Ngai Provincial General Hospital, to suggest and provide reference for antibiotic prescription and improve treatment efficacy, we conducted the study "Investigation of antibiotic resistance in hospital-acquired pneumonia agents at the intensive care unit, Quang Ngai Provincial General Hospital".

II. SUBJECTS AND METHODS

2.1. Study Subjects

The medical records of patients in the ICU diagnosed with HAP after being admitted to the ICU for at least 48 hours, and with no signs of infection at the time of ICU admission. Medical records of patients diagnosed with pneumonia after 48 hours of mechanical ventilation, with no signs of infection at the time of ventilator-associated pneumonia diagnosis were also included. Exclusion criteria were medical records of patients diagnosed or suspected of pneumonia within 48 hours of hospital admission.

2.2. Study methods

2.2.1. Study design

This observational study utilized medical record data from all patients diagnosed and treated for HAP in the ICU from January 2023 to April 2024, satisfying the inclusion and exclusion criteria mentioned above.

2.2.2. Duration of time and location

Duration of time: from January 2023 to April 2024

Location: at the intensive care unit, Quang Ngai Provincial General Hospital

2.2.3. Sample size and sampling method

Sample size: 68 patients with HAP after being admitted to the ICU for at least 48 hours, and with no signs of infection at the time of ICU admission.

Sampling method: A convenience sampling method was applied during the study period.

2.2.4. Study content

- General characteristics of patients: Age and length of hospital stay.

- Microbiological test characteristics: Microbiological test specimens, pathogens isolated in patients with HAP, antibiotic susceptibility in two levels: sensitive (including sensitive and intermediate) and resistant. The study focused on the susceptibility of bacterial strains to antibiotics in four groups: Beta-lactams, Aminoglycosides, Fluoroquinolones, and Glycopeptides.

2.3. Data collection and analysis methods

Data were collected using research forms based on information related to HAP and VAP. To ensure minimal errors, data collection was carefully focused on the research content, with information gathered in an accurate and reliable manner. After collection, data were entered into Microsoft Excel 2016 and analyzed using medical statistics methods with SPSS 27.0 software. Statistical charts were generated using Microsoft Excel 2016.

2.4. Ethical considerations

The study was approved by the Biomedical Research Ethics Committee of Hue University's University of Medicine and Pharmacy, as evidenced by Decision No. 2402 dated June 5, 2023. The research findings ensured the complete anonymity of patient data, adhering to all relevant ethical research guidelines.

III. RESULTS

Table 1. Distribution of age group of patients (n=68)

Age group	n	%
< 60	10	14.7
60-69	6	8.8
70-79	16	23.5
≥ 80	36	52.9
Mean ± SD (Min – Max)	77.38 ± 13.37 (44 – 97)	

The average age of the study sample was 77.38± 13.37, with the youngest patient being 44 years old and the oldest 97 years old. Patients under 60 years old accounted for a low proportion (14.7%), patients aged 70-79 made up 23.5%, and those over 80 years old constituted the largest group (52.9%). The majority of patients in the study sample were female, comprising 61.8%.

Table 2. Length of hospital stay of patients (n=68)

Length of Hospital Stay (days)	n	%
7 – 14 days	14	20.6
15 – 30 days	29	42.6
> 30 days	25	36.8
Mean ± SD (Min – Max)	28.76 ± 18.28 (7 – 99)	

The average length of hospital stay was 28.76± 18.28 days (with a minimum of 7 days and a maximum of 99 days), with a high proportion of patients staying in the hospital for 15 days or more (79.4%).

Table 3. Types of specimens in patients (n=64 specimens)

Specimen Type	n	%
Sputum	57	89.1
Wound exudate/pus	2	3.1
Stool	3	4.7
Urine	2	3.1

Among the cases with microbiological testing, a total of 64 specimens were tested, of which 57 sputum cultures (accounting for 89.1%) isolated 57 bacterial strains. Additionally, there were 2 wound exudate/pus specimens, 3 stool specimens, and 2 urine specimens, none of which yielded bacterial isolates.

Table 4. Bacteria isolated from sputum samples (n=57 sputum cultures)

TT	Bacteria	n	%
1	Acinetobacter baumannii	14	24.6
2	Klebsiella pneumoniae	13	22.8
3	Escherichia coli	10	17.5
4	Proteus mirabilis	9	15.8
5	Pseudomonas aeruginosa	5	8.8
6	Staphylococcus aureus	2	3.5
7	Enterobacter aerogenes	1	1.8
8	Enterococcus faecalis	1	1.8
9	Staphylococcus sciuri	1	1.8
10	Streptococcus spp.	1	1.8

Among the 57 bacterial strains isolated, *A. baumannii* had the highest prevalence (24.6%), followed by *K. pneumoniae* (22.8%), *E. coli* (17.5%), *P. mirabilis* (15.8%), and *P. aeruginosa* (8.8%). Additionally, other bacteria such as *S. aureus* (3.5%), *S. sciuri*, *E. aerogenes*, *E. faecalis*, and *Streptococcus spp.*, each had one strain isolated (1.8%).

Table 5. Sensitivity of isolated bacteria to Beta-lactam antibiotics

Bacteria	Beta-lactam						
	Piperacillin/ Tazobactam	Ceftazidim	Cefepim	Cefotaxim	Ceftriaxon	Imipenem/ Cilastatin	Meropenem
Acinetobacter baumannii	0/14	0/14	0/14	0/14	0/14	1/14	0/14
Escherichia coli	1/10	3/10	4/10	0/10	0/10	3/10	3/10
Enterobacter aerogenes	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Bacteria	Beta-lactam						
	Piperacillin/ Tazobactam	Ceftazidim	Cefepim	Cefotaxim	Ceftriaxon	Imipenem/ Cilastatin	Meropenem
Enterococcus faecalis	0/1	0/1	0/1	0/1	0/1	0/1	0/1
Klebsiella pneumoniae	0/13	1/13	1/13	1/13	1/13	3/13	1/13
Proteus mirabilis	1/9	0/9	1/9	0/9	0/9	4/9	3/9
Pseudomonas aeruginosa	2/5	3/5	4/5	1/5	1/5	5/5	1/5
Staphylococcus aureus	1/2	0/2	0/2	0/2	0/2	1/2	0/2
Staphylococcus sciuri	0/1	0/1	0/1	0/1	0/1	0/1	0/1
Streptococcus spp.	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Note: *Data are presented as the number of sensitive strains/total number of tested strains for each bacterium.*

The isolated bacteria exhibited low sensitivity to the Beta-lactam antibiotics currently available at the hospital. *A. baumannii* showed no sensitivity to any Beta-lactam antibiotics, except for one strain that displayed intermediate sensitivity to imipenem/cilastatin. *E. coli* demonstrated some sensitivity to piperacillin/tazobactam (1/10 strains), cefepime and ceftazidime (3/10 and 4/10 strains, respectively), and imipenem/cilastatin and meropenem (each showing sensitivity in 3/10 tested strains). *K. pneumoniae* had 1/10 strains that remained sensitive to Beta-lactam antibiotics. *P. aeruginosa* retained moderate sensitivity to Beta-lactam antibiotics, while *P. mirabilis* was only sensitive to imipenem/cilastatin and meropenem at low rates. Other bacteria such as *E. aerogenes*, *E. faecalis*, *S. sciuri*, *S. aureus*, and *Streptococcus spp.* had only 1-2 strains tested, all of which were resistant to Beta-lactam antibiotics. Other bacteria such as *E. aerogenes*, *E. faecalis*, *S. sciuri*, *S. aureus*, and *Streptococcus spp.* had only 1-2 strains tested, all of which were resistant to Beta-lactam antibiotics. Therefore, most of the commonly used Beta-lactam antibiotics at the hospital for treating severe infections face high resistance rates.

Table 6. Sensitivity of isolated bacteria to other antibiotic groups

Bacteria	Aminoglycosid			Fluoroquinolon		Glycopeptid	
	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin	Levofloxacin	Vancomycin	Teicoplanin
Acinetobacter baumannii	0/14	0/14	1/14	0/14	0/14	0/14	0/14
Escherichia coli	3/10	0/10	2/10	1/10	1/10	0/10	0/10
Enterobacter aerogenes	1/1	0/1	0/1	0/1	0/1	0/1	0/1
Enterococcus faecalis	0/1	0/1	0/1	1/1	1/1	1/1	0/1

Bacteria	Aminoglycosid			Fluoroquinolon		Glycopeptid	
	Amikacin	Gentamicin	Tobramycin	Ciprofloxacin	Levofloxacin	Vancomycin	Teicoplanin
Klebsiella pneumoniae	3/13	1/13	1/13	1/13	1/13	0/13	0/13
Proteus mirabilis	2/9	0/9	0/9	0/9	0/9	0/9	0/9
Pseudomonas aeruginosa	2/5	1/5	3/5	3/5	3/5	0/5	0/5
Staphylococcus aureus	0/2	0/2	0/2	0/2	0/2	1/2	1/2
Staphylococcus sciuri	0/1	0/1	0/1	0/1	0/1	0/1	0/1
Streptococcus sp.	0/1	0/1	0/1	0/1	0/1	0/1	0/1

Note: *Data are presented as the number of sensitive strains/total number of tested strains for each bacterium.*

The isolated bacteria exhibited low sensitivity to antibiotics in the aminoglycoside, fluoroquinolone, and glycopeptide groups. *A. baumannii* showed no sensitivity to any of the antibiotics in these groups, except for one strain that remained sensitive to tobramycin (1/14 strains). *E. coli* displayed low sensitivity to amikacin, tobramycin, ciprofloxacin, and levofloxacin (1-2/10 strains). *K. pneumoniae* retained low sensitivity to aminoglycosides and ciprofloxacin. *P. aeruginosa* exhibited low sensitivity to aminoglycosides and fluoroquinolones, while *P. mirabilis* was only sensitive to amikacin at a low rate. Other bacteria such as *E. aerogenes*, *E. faecalis*, *S. sciuri*, *S. aureus*, and *Streptococcus spp.* had only 1-2 strains tested, all of which were resistant to aminoglycosides, fluoroquinolones, and glycopeptides antibiotics groups.

IV. DISCUSSION

The average age of the study sample was 77.38, with the youngest patient being 44 years old and the oldest 97 years old. This average age is lower than that reported in the study by Le Quang Phuong at Huu Nghi Hospital (2021) [7], where the average age was 83.5 years, and higher than Jones' study in the United States, where the average age was 66 years [8]. Patients under 60 years old accounted for a small proportion (14.7%), patients aged 70-79 made up 23.5%, and those over 80 years old constituted the largest group (52.9%). As a result, the proportion of patients over 60 years old was high, which is consistent with the study by Nguyen Buu Huy (2018) [9], the study by Nguyen Thanh Nghiem and colleagues at Can Tho City General Hospital (2022) [10], where the proportion of patients over 60 years old was 73.5%, and a study at Cho Ray Hospital from 2021-2022, where the proportion of patients over 65 years old was 59.9% [11]. This result aligns with the 2023 recommendations of the Vietnam Respiratory Society [13], which state that one of the risk factors for HAP and VAP is advanced age (>55 years).

The average length of hospital stay was 28.76 ± 18.28 days (with a minimum of 7 days and a maximum of 99 days), with a high proportion of patients staying in the hospital for 15 days or more (79.4%). Most patients diagnosed with HAP had prolonged hospital stays. Prolonged hospitalization, especially in the ICU, is one of the risk factors for HAP involving multidrug-resistant bacteria. Our study's results are higher than those of Nguyen Thanh Nghiem's study at Can Tho City General Hospital (2022) [10], where the average length of stay was 21.7 ± 11.1 days, but lower than Nguyen Thi Nguyet's study at Tuyen Quang Provincial General Hospital (2022) [6], which reported an average of 35 ± 22.9 days.

Thus, the proportion of patients diagnosed with HAP increases with longer hospital stays, which aligns with the 2023 guidelines from the Vietnam Respiratory and Intensive Care Society and a study conducted in European countries during 2011-2012, which found that HAP was significantly associated with advanced age, male gender, endotracheal intubation, and prolonged hospital stays [12].

There was a total of 64 specimens isolated from cases with microbiological testing indications, of which 57 were sputum cultures (accounting for 89.1%), and 57 bacterial strains were isolated. In addition, there were 2 wound exudate/pus samples, 3 stool samples, and 2 urine samples, but no bacteria were isolated from these samples. Most of the bacteria isolated were Gram-negative, with Gram-positive bacteria also being detected but at a lower rate. The bacteria isolated included *A. baumannii* with the highest prevalence (24.6%), followed by *K. pneumoniae* (22.8%), *E. coli* (17.5%), *P. mirabilis* (15.8%), and *P. aeruginosa* (8.8%). Other bacteria such as *S. aureus* and *E. aerogenes* were isolated at lower rates. These results are consistent with previous studies conducted in Vietnam, such as that of Nguyen Buu Huy (where *A. baumannii* was the main pathogen, accounting for 40.9%) [9], Nguyen Van Dung (2022) at Thanh Hoa Provincial General Hospital (with *A. baumannii* accounting for 32.38%) [13], and Tran Nguyen Ai Thanh (2020-2023) at Thu Duc City Hospital (*A. baumannii* accounted for 30.85%) [14]. These findings also align with a 10-year study in China on HAP, which found that *A. baumannii* was the predominant bacterium (26.4%) [15].

The antibiotic resistance rates of the isolated bacteria were relatively high, with most bacteria showing resistance to the antibiotics recommended for treating HAP. Notably, *A. baumannii* showed no sensitivity to any Beta-lactam antibiotics, except for one strain that displayed intermediate sensitivity to imipenem/cilastatin. The *A. baumannii* strains were also not sensitive to any of the other tested antibiotic groups, except for one strain sensitive to tobramycin (1/14 strains). The antibiogram results indicate an alarming resistance trend in *A. baumannii*, with antibiotics listed in the Ministry of Health's priority antibiotic management list already facing resistance (only meropenem had a low resistance rate). Our findings are consistent with the 2020 Vietnam Antibiotic Resistance Surveillance Report [16], which noted that *A. baumannii* is the leading cause of lower respiratory tract infections and that its sensitivity to the recommended antibiotics for hospital-acquired pneumonia treatment is low. Multidrug-resistant *A. baumannii* is becoming increasingly prevalent, and the antibacterial activity of the Colistin + Imipenem combination was superior to that of any other two-drug combinations [17].

Escherichia coli is one of the bacteria isolated from microbiological results in HAP cases and is also multidrug-resistant. This bacterium can produce two enzymes, extended-spectrum β-lactamase (ESBL) and carbapenemase, which alter and destroy the chemical structure of antibiotics, leading to antibiotic resistance. Our findings show that *E.coli* exhibited only a very small proportion of sensitivity to some antibiotics, including piperacillin/tazobactam (1/10 strains), cefepime and ceftazidime (3/10 and 4/10 strains, respectively), and imipenem/cilastatin and meropenem (sensitive in 3/10 tested strains each). The bacterium displayed resistance but not complete resistance to the Beta-lactam, macrolide, tetracycline, and glycopeptide antibiotic groups, and it was less resistant to piperacillin/tazobactam and amoxicillin/clavulanic acid. Our results are similar to those of Nguyen Van Dung's study at Thanh Hoa Provincial General Hospital (2022), in which *E. coli* showed high sensitivity to Meropenem (75%) and Imipenem (75%) [10]. In Nguyen Vinh Nghi and colleagues' 2017 study, *E. coli* exhibited 100% resistance to ampicillin [18].

Most of the *K. pneumoniae* strains were only sensitive to imipenem/cilastatin and meropenem at low rates, and they were highly resistant to cephalosporins, aminoglycosides, and fluoroquinolones, but exhibited less resistance to piperacillin/tazobactam, amoxicillin/clavulanic acid, meropenem, macrolides, tetracyclines, and glycopeptides. In general, *P. aeruginosa* exhibited less resistance to beta-lactam and fluoroquinolone antibiotics and was not resistant to aminoglycosides (only slightly resistant to tobramycin) or the fluoroquinolone, macrolide, tetracycline, and glycopeptide groups. The antibiotic resistance rate of *P. aeruginosa* in our study was lower than in Mai Vu Kha's 2019 study, possibly due to the smaller sample size and focus on patients specifically treated in the ICU in our

research. *Proteus mirabilis* was only sensitive to imipenem/cilastatin and meropenem at a low rate. Other bacteria, such as *Enterobacter aerogenes*, *Enterococcus faecalis*, *Staphylococcus sciuri*, *Staphylococcus aureus*, and *Streptococcus spp.*, had only 1-2 strains tested, all of which were resistant to Beta-lactam antibiotics.

Through this study, we found that the common pathogens causing HAP in the ICU of Quang Ngai Provincial General Hospital are multidrug-resistant Gram-negative bacteria. This poses a significant challenge in the use of antibiotics to treat patients, especially those with severe infections.

V. CONCLUSION

The isolated bacteria were predominantly *A. baumannii* (24.6%), *K. pneumoniae* (22.8%), *E. coli* (17.5%), *P. mirabilis* (15.8%), and *P. aeruginosa* (8.8%). The antibiotic resistance rates of the isolated bacteria were relatively high, with most showing resistance to the antibiotics recommended for treating hospital-acquired pneumonia. *A. baumannii* showed no sensitivity to any Beta-lactam antibiotics, except for one strain that exhibited intermediate sensitivity to imipenem/cilastatin. *Escherichia coli* exhibited a very low rate of sensitivity to some antibiotics. Most *K. pneumoniae* strains were only sensitive to imipenem/cilastatin and meropenem at low rates, and they were highly resistant to cephalosporins, aminoglycosides, and fluoroquinolones.

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