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CHARACTERIZATION OF *ESCHERICHIA COLI* ISOLATED FROM CHRONIC WOUND PATIENTS IN LE HUU TRAC NATIONAL BURNS HOSPITAL

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SUMMARY

Escherichia coli is responsible for many infections that affect burns and wound healing. They are highly resistant to antibiotics. Thus, the antimicrobial susceptibility pattern in burn and chronic wound infection may be useful in treating E. coli infections.

This study aimed to determine the prevalence and the antibiotic susceptibility of E. coli in burn and chronic wound infection in the Le Huu Trac National Burns Hospital from January 2021 to May 2023. E. coli were identified and the antibiotics susceptibility testing was performed using the VITEK 2 automated system. A total of 4326 samples were cultured. There were 41 (0.95%) samples positive and 4285 (99.05%) samples negative for E. coli. The E. coli infected were more common in males (n = 22; 53.66%) than in female patients (n = 19, 46.34%). The infection was the highest in farmers (n = 25; 60.98%), followed by the self-employed (n = 8; 19.51%) and retired (n = 8; 19.51%).

E. coli was highly sensitive to Fosfomycin (100%), Carbapenem class (> 90%), Colistin (92.31%), and Amikacin (87.18%) but resistant to Pefloxacin (100%), Minocycline (100%), Penicillins class (> 90%), and Trimethoprim-Sulfamethoxazole (84.62%). The use of Fosfomycin, carbapenem class, Colistin, and Amikacin are effective against E. coli and can help prevent the spread of infection.

***Keywords**: Escherichia coli (E. Coli), antibiotic, resistant, burns, wound*

1. INTRODUCTION

Burn injury and chronic wounds is a global public health concern. It causes damage to the skin - the largest organ in the human body. The skin functions as a barrier against infection, immunological defense, homeostasis, thermoregulation, and sensation. Burn injury results in 265,000 deaths annually, with nearly half of these occurring in South-East Asia [1].

Infection is a leading cause of mortality and morbidity, it also prolongs hospital stay following burn injury and chronic wounds. It causes a significant financial burden on developing countries such as Vietnam. Most burn wounds and chronic wounds are

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contaminated by bacteria from normal skin or hospital environments. Nosocomial infections are more common in burn wound and chronic wound patients compared to other wards [2]. Infection is one of the largest barriers to improved burn wounds and chronic wound outcomes in Vietnam. Most burn injuries and chronic wounds occur in rural areas. This further complicates their timely and appropriate treatment due to a lack of finances and infrastructure.

E. coli can be found as part of the normal human intestinal flora that may cause infections with potentially severe complications, including death. *E. coli* is a leading cause of community-acquired sepsis, a life-threatening condition. *E. coli* is the most common pathogen cause of death relevant to antibiotic resistance, particularly among older adults [3]. The burn wound and chronic wound patients may be at greater risk of *E. coli* infection and may be more challenging to manage due to the increased likelihood of antibiotic resistance.

The *E. coli* antimicrobial sensitivity and resistance data are important to facilitate treatment before antibiotic susceptibility results and prevent further multidrug-resistant organisms. Currently very few data on the *E. coli* infected and its antibiotic-resistant pattern among burn injury and chronic wounds infected patients in Vietnam. The *E. coli* antibiotic-resistant pattern data is important in empirical antibiotic prescribing and preventing further multidrug-resistant organisms. Thus, this study aims to document the *E. coli* profile of burn wounds and chronic wound infections at the Le Huu Trac National Burns Hospital.

2. MATERIALS AND METHODS

This was a retrospective study of burn wounds and chronic wound infection at the Le Huu Trac National Burns Hospital. The *E. coli* identification data were collected from January 2021 to May 2023 (29 months), and the antibiotic susceptibility testing data was used during the study period and before January 2021. The baseline characteristics specific burn wounds, and chronic wound infection data were collected.

2.1. Study Design

A total of 4.326 samples were collected; these samples included sterilized swabs, tissues from the infected wounds, urine, sputum, and blood.

2.2. Isolation, Identification, and Antimicrobial Susceptibility Testing

Standard microbiological techniques were used to culture samples. Gram staining, colony morphology. The identification and antimicrobial susceptibility testing were performed using the VITEK 2 automated system.

2.3. Data Analysis

Data were analyzed using R software version 4.3.0 (R Foundation for Statistical Computing, Vienna, Austria). $P < 0.05$ was considered statistically significant.

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3. RESULTS

3.1. Patient baseline characteristic

Table 3.1. *E.* coli infected patient demographics

Characteristic	n	Overall, n = 41	Female, n = 19	Male, n = 22	*p-value*
Age, median (min, max)	41	69 (47, 90)	81 (66, 90)	56 (47, 80)	< 0.001[1]
Occupation, n/N (%)	41				0.013[2]
Farmer		25/41 (60.98%)	11/19 (57.89%)	14/22 (63.64%)	
Retire and > 60		8/41 (19.51%)	7/19 (36.84%)	1/22 (4.55%)	
Self-employed		8/41 (19.51%)	1/19 (5.26%)	7/22 (31.82%)	
Outcome, n/N (%)	41				< 0.001[2]
Death		3/41 (7.32%)	0/19 (0.00%)	3 /22 (13.64%)	
Excellent		9/41 (21.95%)	5/19 (26.32%)	4/22 (18.18%)	
Fair		5/41 (12.20%)	5/19 (26.32%)	0/22 (0.00%)	
Good		10/41 (24.39%)	8/19 (42.11%)	2/22 (9.09%)	
Poor		11/41 (26.83%)	1/19 (5.26%)	10/22 (45.45%)	
Unidentified		3/41 (7.32%)	0/19 (0.00%)	3/22 (13.64%)	
Length of Stay, median (min, max)	38	18 (1, 108)	32 (7, 108)	13 (1, 63)	0.017[1]
Unknown		3	0	3	

[1]*Wilcoxon rank sum test*
[2]*Fisher's exact test*

The demographics of patients are presented in Table 3.1. The total of the infected cases were 41, male population (n = 22, 53.66%), female population (n = 19, 46.34%). The mean age of the cohort was 69.93 (median 69, range 47 - 90). The majority of infected patients were found in farmers (n = 25, 60.98%), followed by retired and self-employed (n = 8, 19.51%, each group). Length of stay at the hospital averaged 28.84 days (median 18, range 1 - 108). The mortality rate was 7.32% (n = 3).

3.2. Antibiotic susceptibility testing

Table 3.2. Antibiotic Susceptibility Pattern of *E. coli*

Classes	Antibiotics	Sensitive n (%)	Resistant n (%)	Intermediate n (%)	Total
Aminoglycosides	Amikacin	34 (87.18)	5 (12.82)	0 (0)	39
	Gentamicin	20 (51.28)	19 (48.72)	0 (0)	39
	Tobramycin	9 (34.62)	13 (50)	4 (15.38)	26
	Isepamicin	1 (33.33)	2 (66.67)	0 (0)	3
Carbapenem	Imipenem	35 (89.74)	4 (10.26)	0 (0)	39
	Meropenem	36 (92.31)	1 (2.56)	2 (5.13)	39
	Ertapenem	12 (92.31)	0 (0)	1 (7.69)	13
Fluoroquinolone	Ciprofloxacin	6 (15.38)	31 (79.49)	2 (5.13)	39
	Levofloxacin	3 (13.04)	18 (78.26)	2 (8.7)	23
	Norfloxacine	3 (23.08)	10 (76.92)	0 (0)	13
	Pefloxacin	0 (0)	3 (100)	0 (0)	3
Penicillins	Ampicillin	0 (0)	13 (100)	0 (0)	13
	Piperacillin	1 (3.85)	25 (96.15)	0 (0)	26
	Ticarcillin	1 (3.85)	24 (92.31)	1 (3.85)	26
Beta-lactam combination agents	Ticarcillin-clavulanate	6 (23.08)	11 (42.31)	9 (34.62)	26
	Piperacillin - Tazobactam	24 (80)	4 (13.33)	2 (6.67)	30
	Amoxicillin - clavulanic acid	6 (46.15)	5 (38.46)	2 (15.38)	13
Cefems	Cefepime	27 (69.23)	12 (30.77)	0 (0)	39
	Cefotaxime	3 (23.08)	10 (76.92)	0 (0)	13
	Ceftazidime	16 (41.03)	21 (53.85)	2 (5.13)	39
Monobactam	Aztreonam	9 (34.62)	16 (61.54)	1 (3.85)	26
Lipopeptides	Colistin	12 (92.31)	1 (7.69)	0 (0)	13
Fosfoycins	Fosfomycin	13 (100)	0 (0)	0 (0)	13
Tetracyclines	Minocycline	0 (0)	3 (100)	0 (0)	3
Folate Pathway Antagonists	Trimethoprim - sulfamethoxazole	6 (15.38)	33 (84.62)	0 (0)	39

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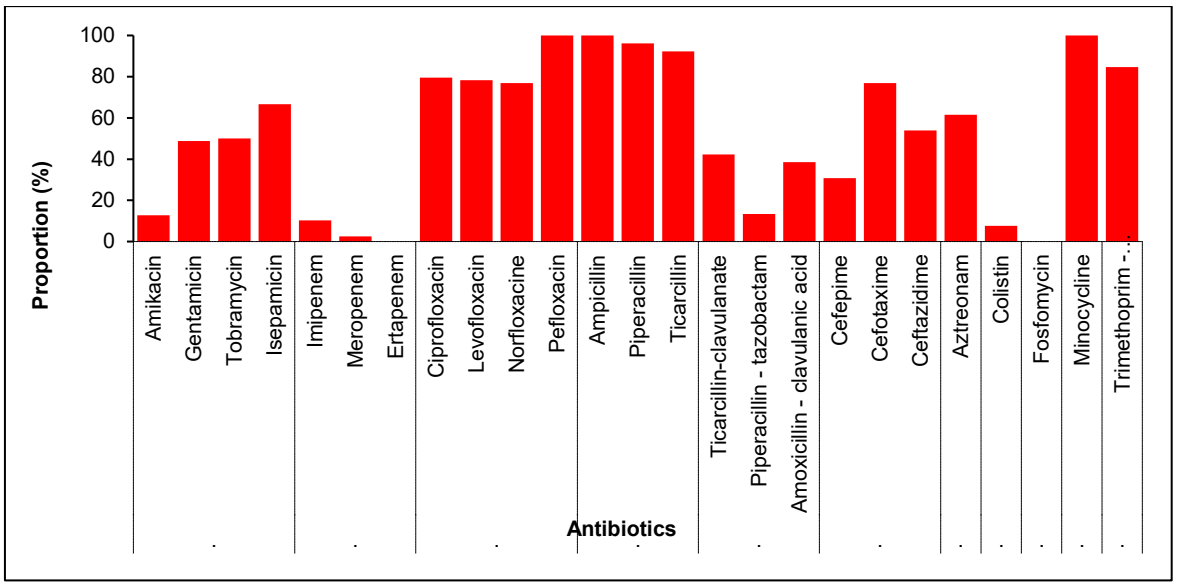

Figure 3.1. Antibiotic-resistant patterns

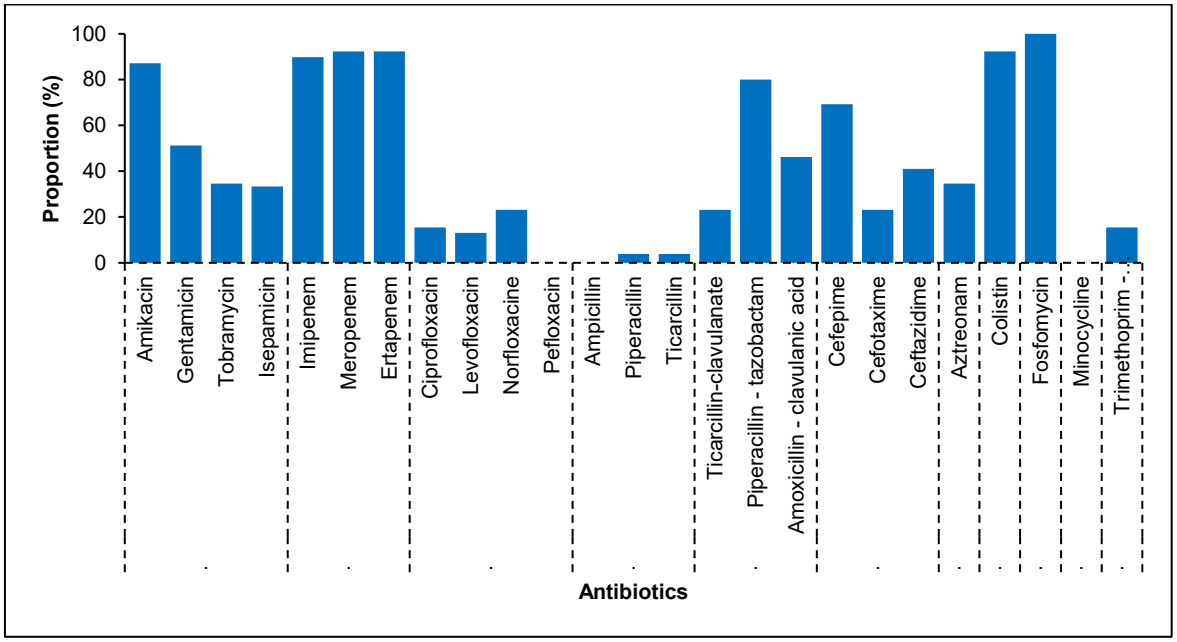

Figure 3.2. Antibiotic sensitivity patterns

Antibiotic susceptibility testing of *E. coli* is presented in Table 3.2. The resistance and sensitivity of *E. coli* to antibiotics are presented in Figure 3.1 and Figure 3.2, respectively.

E. coli was the highest resistant to Pefloxacin (100%), Minocycline (100%), Penicillins class (> 90%), and Trimethoprim-Sulfamethoxazole (84.62%).

E. coli was the highest sensitive to Fosfomycin (100%), Carbapenem class (> 90%), Colistin (92.31%), and Amikacin (87.18%).

4. DISCUSSION

The present study aims to highlight the *E. coli* sensitive and resistant to antibiotics causing chronic wound infections in Le Huu Trac National Burns Hospital.

The majority of chronic wound patients were males (53.66%) compared to females (46.34%), this finding is in line with other studies [4, 5]. This may be due to rather than women, men tend to be exposed to risk factors without taking sufficient precautionary measures [4]. The majority of the chronic wound patients in this study were adults. Our data are consistent with the previous study [6].

E. coli antimicrobial resistance was a serious problem in this cohort. Risk factors for acquiring resistant *E. coli* include previous hospitalization, invasive procedures, advancing age, and inappropriate antibiotic prescribing [1]. The *E. coli* infected patients rate was approximately 1.02%, which is lower than in other studies [7].

In the present study, *E. coli* was highly sensitive to Fosfomycin (100%), Carbapenem class (> 90%), Colistin (92.31%), and Amikacin (87.18%) but resistant to Pefloxacin (100%), minocycline (100%), Penicillins class (> 90%), and Trimethoprim-Sulfamethoxazole (84.62%). The results were consistent with other studies that a low resistance rate was seen for meropenem and colistin (8.33%); and the highest resistance was seen for Ampicillin (100%) followed by Trimethoprim/Sulfamethoxazole (91.67%), Amoxicillin/clavulanic acid (83.33%), Aminoglycosides (66.67%), Ciprofloxacin (66.67%) [8]. Such high resistance may be due to the inappropriate use of these antibiotics. This study was performed on the VITEK 2 automated system for identification and antibiotics susceptibility testing that provides accurate results and removes the requirement of human analysis and error of results [9].

Proper antibiotic prescribing can be improved by education on infection control for medical doctors and by the use of burn unit antibiograms according to guidelines. In addition, cleaning protocols should be adhered to as they are highly effective in removing pathogens. The *E. coli* resistance increased with the length of stay in the hospital, possibly due to the pathogens adapting to the hospital environment or the improper use of antibiotics. Amikacin was most effective for Gram-negative organisms.

The biggest challenge in managing burn and chronic wound infections is the appropriate selection and use of antibiotics. The burn wound and chronic wound microbial evolve rapidly, with multiple pathogens species invading the tissue at one time. Thus, the use of antibiotics is quite complicated in infected burn wounds and chronic wounds. The ineffective and non-regulated use of antimicrobials causes the emergence of multidrug-resistant bacteria which threaten the prognosis of burn injuries and chronic wounds. Therefore, constant monitoring of infections and antibiotic susceptibility patterns in burn and chronic wound patients is critically important [2, 10].

Antibiotic resistance is gradually swooping down on all the antibiotic classes. The multidrug-resistant pathogens may persist for months in a

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patient's body. Therefore, microbiological surveillance and identification of pathogens should be done before using antibiotics. Moreover, the inappropriate use of antibiotics should be avoided. Pathogens of burn wounds and chronic wounds are dynamic changing and diversifying over time [10]. The antibiotic susceptibility patterns of the burn wound and chronic wound pathogens are critical. Physicians must evaluate the wound to spot the most common organisms causing infections. The Le Huu Trac National Burns Hospital should regularly check on the changing antibiotic sensitivity data for common pathogens and be recognized as a core component of the burn and chronic wound treatment protocol. Therefore, this study is important for the establishment of a strict antibiotic usage policy in hospitals.

The study results showed that Fosfomycin, Carbapenem class, Colistin, and Amikacin are effective against *E. coli;* and Pefloxacin, Minocycline, Penicillins class, and Trimethoprim-Sulfamethoxazole are very low-effective against *E. coli*.

5. CONCLUSIONS

Fosfomycin, Carbapenem class, Colistin, and Amikacin were good choices in treating *E. coli*-infected chronic wound and burn wound patients at the Le Huu Trac National Burns Hospital. Further infection surveillance should be encouraged to help facilitate appropriate antibiotic prescribing and to prevent the further emergence of multidrug-resistant *E. coli*.

Conflict of interest

None declared.

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