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Isolation of Pyogenic Microorganisms from Infected Wounds in the General Surgery and Orthopedic & Traumatology Departments of the Near East University Hospital: A Retrospective Study

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Abstract

BACKGROUND/AIMS: Wound infection is characterized as the presence of a wound environment characterized by microorganisms in adequately large numbers, or of adequate virulence to aggregate an immune response locally and/or systemically. The aim of this study, conducted in a university hospital in North Cyprus, was to determine the microorganisms that cause pus formation in wound infections.

MATERIALS AND METHODS: One hundred and eighty-five samples were analyzed for this study from the period of September, 2015 to August, 2019. The samples were analyzed in the Near East University Hospital Microbiology Laboratory, North Cyprus. The samples were collected from two different departments. The sensitivity pattern of the organisms was determined by the BD Phoenix instrument. The SPSS version 22 was used for statistical analysis.

RESULTS: The orthopedic unit had a total of 123 patient samples while the general surgery unit had a total of 62 patient samples. Culture was positive in 56 (45.5%) of the 123 samples taken from the orthopedic clinic. There was no significant difference between gender and wound infection in the samples taken from the orthopedic clinic (p=0.640). The total number of outpatients was 15 (12.2%) and the number of inpatients was 108 (87.8%) in the orthopedic department. In the general surgery department, there were a total of 62 patient samples and a total of 41 (66.1%) were culture positive. The most commonly seen bacteria was *Escherichia coli* (22.6%).

CONCLUSION: With the aim to determine a summarized analysis of wound microbiology, and the current opinions and controversies regarding wound treatment, this retrospective study attempted to assess the microbiological aspects which are important to the administration of microorganisms in wounds.

Keywords: Microorganisms, wound infection, resistance

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INTRODUCTION

Wound infection is characterized as the presence of a wound environment characterized by microorganisms in adequately large numbers, or of adequate virulence to aggregate an immune response locally and/or systemically.

A break in skin integrity can allow bacteria to enter the body and proliferate. Absent of the protective barrier of the skin, sensitive tissues in the wound bed may lead to microorganism colonization. The proliferation of microorganisms in a wound can disrupt wound healing as it can cause local tissue damage.[1] The subcutaneous or underlying tissue provides a moist, nutritious environment, which facilitates microbial colonization and generation. Wound colonization is poly-microbial, which means potentially pathogenic microorganisms are present, thus any wound is at risk of becoming infected.[2]

Staphylococcus aureus (*S. aureus*) and *Pseudomonas aeruginosa* (*P. aeruginosa*) are the most common pyogenic bacteria associated with wound infections. These two bacteria together account for up to 20-40% of all nosocomial, post-surgery and burn infections. *Enterococci* and *Enterobacter* are other microorganisms which have also been associated with wound infections, especially after abdominal surgery in immunocompromised patients.[3] The above mentioned risks and antibiotic resistance make wound infections a global problem. The antimicrobial resistance factors include changes in microbial ecology, genetics and the non-selective use of antimicrobial agents. Methicillin-resistant *S. aureus* (MRSA), and vancomycin-resistant *Enterococci* (VRE) are two medically relevant examples.[4]

The aim of this study was to determine the microorganisms which cause pus formation in wound infections. The present study was conducted in North Cyprus between September, 2015 and December, 2019.

MATERIALS AND METHODS

One hundred and eighty-five samples were analyzed for this study from the period of September, 2015 to August, 2019. The samples were analyzed in the Near East University Hospital Microbiology Laboratory, North Cyprus. These samples were collected from two different departments (general surgery and orthopedic departments). These samples only included wound and pus culture tests. Demographic information (age, sex) was obtained from the patients' medical records. The sensitivity pattern of the pyogenic organisms was determined against commonly used antibiotics using a BD Phoenix instrument. The samples were assigned accordingly and were subject to analysis in the Microbiology Laboratory at the Near East University Hospital, Nicosia, North Cyprus. Near East University Ethics Committee approval (approval number: 2020/76) was obtained for this study.

Statistical Analysis

After the data were collected, they were analyzed using SPSS (Statistical Package for the Social Sciences) version 22 and the results were compared with the literature. Since our study was single-centered, it does not reflect the whole of North Cyprus and this is seen as a limitation. Therefore, we think that multi-center studies should be conducted.

RESULTS

The orthopedic unit had a total of 123 patient samples, while the general surgery unit had a total of 62 patient samples from the period of September, 2015 to August, 2019 (Table 1).

Out of the 123 samples cultured from the orthopedic department, 56 (45.5%) were found to be culture positive, while 67 (54.5%) were culture negative. Out of the 123 patients from the orthopedic unit, the minimum age was 21 years, the maximum was 87 years and the mean age of the patients in the orthopedic department was 65 years. The number of male patients was 40 (32.5%) and females was 83 (67.5%). No significant difference was found between gender and wound infection (p=0.640). The total number of outpatients was 15 (12.2%) and inpatients was 108 (87.8%) in the orthopedic department. No significant difference was found between the outpatients and inpatients in terms of wound infections (p=0.517). The predominant bacteria was *Escherichia coli* (*E. coli*) (11.3%) followed by *P. aeruginosa* (8.1%), *S. aureus* (8.1%), coagulase negative *Staphylococci* (CoNS) (4.8%), *Enterococcus faecium* (*E. faecium*) (2.4%), *Enterococcus faecalis* (2.4%), *Candida* species (1.6%), *Citrobacter* species (1.6%), *Acinetobacter baumannii* (*A. baumannii*) (1.6%), *Proteus* species (1.6%), *Enterobacter* species (0.8%), *Klebsiella pneumoniae* (*K. pneumonia*) (1.1%) and *Burkholderia cepacia* (0.8%) (Figure 1). For the Gram-negative bacteria, *A. baumannii* (n=2) showed resistance to almost all the antibiotics and was found to have sensitivity only to trimethoprim-sulfamethoxazole (SXT) and tigecycline. *P. aeruginosa* (n=10) was found to have high resistance to aztreonam (ATM) (80%). *Enterobacteriacae* (n=20) was found to have the highest resistance to SXT (63%).

In the general surgery department, there were a total of 62 patient samples considered in this study and a total of 41 (66.1%) were culture positive. The minimum age was 19 years, the maximum age was 89 years and the mean age of the patients was 52.37±20.99 years. The number of males was 23 (37.1%) and the number of females was 39 (62.9%). No significant difference was found between the genders and

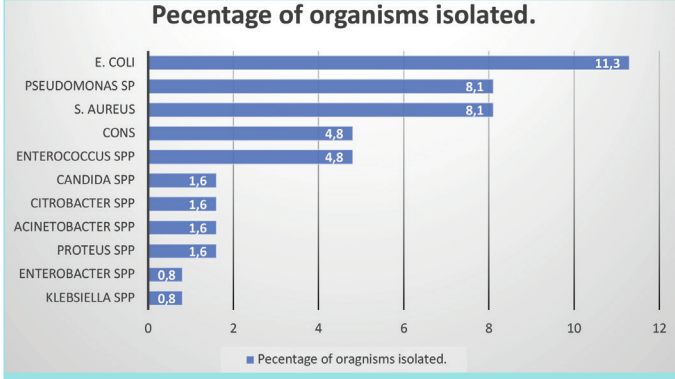

Figure 1. Percentage of organism isolated from the orthopedic department.

Table 1. Percentage of patients from the two different departments

	Number	Percentage (%)
Orthopedic	123	66.5
General surgery	62	33.5
Total	185	100.0

wound infections (p=0.907). The total number of outpatients was 30 (48.4%) and inpatients was 32 (51.6%) in the general surgery department. No significant difference was found between the outpatients and the inpatients in terms of wound infections (p=0.652). The predominant bacteria type was *E. coli.* (22.6%), followed by *P. areuginosa* (9.7%), CoNS (9.7%), *Proteus* species (4.8%), *S. aureus* (4.8%), *Citrobacter* species (4.8%), *K. pneumoniae* (3.2%), *E. faecium* (1.6%), *Candida* species (1.6%), *A. baumannii* (1.6%), and *Enterobacter cloacae* (1.6%) (Figure 2).

For the Gram-negative bacteria, *A. baumannii* (n=1) was resistant to almost all the antibiotics and sensitivity to tigecycline (100%). *P. aeruginosa* (n=6) was found to have the highest resistance to ATM (50%). *Enterobacteriacae* (n=23) was found to have the highest resistance to amoxicillin/clavulanate (100%). The Gram-positive bacteria sensitivity and resistance pattern in CoNS (n=6) was found to have the highest resistance to ciprofloxacin (CIP) (33%) and SXT (33%). *S. aureus* (n=3) had high resistance to CIP (33%). *E. faecium* (n=1) had high resistance to CIP (100%) and erythromycin (100%).

DISCUSSION

Wound infections are the main problem for nosocomial infections despite the continuous progress in surgery and antibiotic prophylaxis. Therefore, they important for morbidity and mortality.[5,6] Wound infection is a main concern among health care practitioners.[7] Whatever the cause, wounds have an important but often unrecognized effect on those who suffer from them and on the health care system. The phenomenon of wounds has been called the "silent epidemic".[8]

This study showed that the most frequently isolated microorganism type from both departments participating in this study was *E. coli,* which had the highest percentages. Also, in the orthopedic department, the gram-positive bacteria isolated showed that the percentage of MRCN was 3/6 (50%), MRSA was 5/10 (50%), and VRSA was 1/10 (10%). Infections in wounds are aerobic or facultative pathogens, for example *S. aureus*, *P. aeruginosa*, or beta-hemolytic *Streptococci*. There is reported to be a large prevalence of *S. aureus* in wounds.[8,9] According to studies on wound infections, the responsible bacteria found in colonized wounds is one-third anaerobic bacteria, however, the responsible bacteria found in infected wounds is 50% anaerobic bacteria. Aerobic and anaerobic pathogens may lead to infection with more than one type of the bacteria (poly-microbial), therefore, broad-spectrum antibiotics may be effective in the administration of infected wounds. Our result showed that only clindamycin or metronidazole with an aminoglycoside

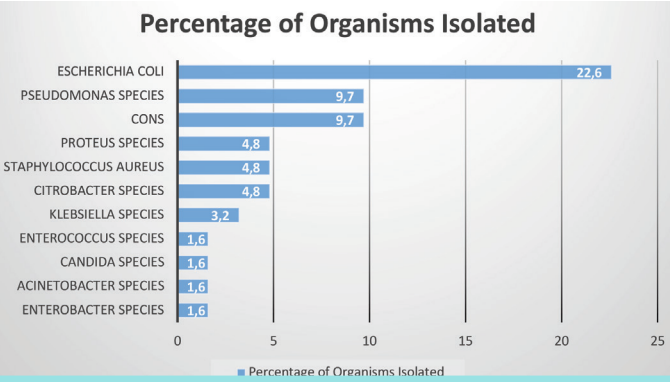

Figure 2. Percentage of organisms isolated from the general surgery department.

(e.g., gentamicin) or a cephalosporin (e.g., cefuroxime or cefotaxime) was confirmed to be highly effective. In the United States, cefoxitin or cephamycin are used as a single agent for the treatment of already established infections and not as prophylactics. However, new classes of antibiotics, such as ureidopenicillins, carbapenems, and B-lactam/B-lactamase inhibitor combinations have increased the choice for prophylactic and therapeutic treatment.[10] Since *S. aureus* is the most commonly isolated microorganism seen in complicated infections of wounds, the most common treatments are with cephalosporin, macrolides, clindamycin, and semi-synthetic penicillin (oxacillin).[10] If strains of MRSA are complicated, then vancomycin and teicoplanin are another choice for treatment.[9] In another study, poly-microbial growth was reported from 59.6% of cultures and 61.5% of multidrug-resistant organisms. Our results are similar to other studies.[11,12] In selecting antibiotics for the treatment of wound infections, we need to have an understanding of the normal flora, the antimicrobial patterns of the microorganisms, and antimicrobial agents. The factors involved in the wound from colonization to infection and even up to healing can help practitioners to clarify clinical findings and microbiological investigations of wounds. In term of topical antiseptics, bacterial resistance persists, but new antimicrobial agents are broadly effective and have a low incidence of resistance.[13]

Furthermore, the microbiology of wounds has been actively researched in recent years, but there is still much to be learned and discovered about the microbial mechanisms these pyogenic microorganisms use to induce infection and prevent wound healing.[10,14]

CONCLUSION

As a result, debate and theories regarding microbial involvement in wound healing is likely to continue.

With the aim of giving a summarized analysis of wound microbiology, together with the current opinions and controversies regarding wound evaluation and treatment, this retrospective study attempted to address certain microbiological aspects which are important to the management of microorganisms in wounds.[15]

MAIN POINTS

- Wound infection is characterized as the presence of a wound environment characterized by microorganisms in adequately large numbers, or of adequate virulence to aggregate an immune response locally and/or systemically.
- The risk factors stated in this study and antibiotic resistance problems have made wound infections a global problem.
- Antimicrobial resistance factors include changes in the microbial ecology, genetics and the non-selective use of antimicrobial agents. MRSA, and VRE are two relevant examples.
- The aim of this work was to determine those microorganisms which cause pus formation in wound infections in North Cyprus.

ETHICS

Ethics Committee Approval: Near East University Ethics Committee approval (approval number: 2020/76) was obtained for this study.

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Conception: E.G., N.Ç., K.S., Design: E.G., N.Ç., K.S., Supervision: H.E., E.E., N.Ç., K.S., Fundings: H.E., E.E., Data Collection and/or Processing: H.A., E.G., Analysis and/or Interpretation: E.G., Literature Review: M.G., Writing: M.G., Critical Review: M.G., K.S.

DISCLOSURES

Conflict of Interest: No conflict of interest was declared by the authors.

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REFERENCES

1. Siddiqui AR, Bernstein JM. Chronic wound infection: Facts and controversies. Clin Dermatol. 2010; 28: 519-26.
2. Dai T, Huang Y, Sharma K, Hashmi T, Kurup D, Hamblin MR. Topical antimicrobials for burn wound infections. Recent Pat Antiinfect Drug Discov. 2010; 5: 124-51.
3. Kotz P, Fisher J, McCluskey P, Hartwell D, Dharma H. Use of a new silver barrier dressing, ALLEVYN Ag in exuding chronic wounds. Int Wound J. 2019; 6: 186-94.
4. Al-Waili N, Salom K, Al-Ghamdi A. Honey for wound healing, ulcers, and burns; data supporting its use in clinical practice. ScientificWorldJournal. 2011; 11: 766-87.
5. Tesfahunegn Z, Asrat D, Woldeamanuel Y, Estifanos K. Bacteriology of surgical site and catheter related urinary tract infections among patients admitted in Mekelle Hospital, Mekelle, Tigray, Ethiopia. Ethiopian Med J. 2009; 47: 117-22.
6. Ashby E, Haddad S, O'Donnell E, Wilson AP. How will surgical site infection be measured to ensure "high quality care for all"?. J Bone Joint Surg Br. 2010; 92: 1294-9.
7. Alexander MF. Wound infection. In: Nursing Practice Hospital and Home, the Adult. Alexander MF, Fawcett JN, Runciman PJ, (editors). New York: Churchill Livingstone. 1994; p. 703.
8. Smith & Nephew Foundation. Skin breakdown-the silent epidemic. Smith & Nephew Foundation, Hull; 2007.
9. Mayhall CG. Surgical infections including burns. In: R. P. Wenzel Prevention and control of nosocomial infections (2nd edition). The Williams & Wilkins Co. Baltimore. 1993; p. 614-64.
10. Surucuoglu S, Gazi H, Kurutepe S, Ozkutuk N, Ozbakkaloglu B. Bacteriology of surgical wound infections in a tertiary care hospital in Turkey. East Afr Med J. 2005; 82: 331-6.
11. Otokunefor V, Datubo-Brown DD. Bacteriology of wound infections in the surgical wards of a teaching hospital. West Afr J Med. 1990; 9: 285-90.
12. Uçkay I, Sax H, Harbarth S, Bernard L, Pittet D. Multi-resistant infections in repatriated patients after natural disasters: lessons learned from the 2004 tsunami for hospital infection control. J Hosp Infect. 2008; 68: 1-8.
13. Wilson P, Gibbons C, Raeves C, Hogson B, Liu M, Plummer D, et al. Surgical wound infection as a performance indicator: agreement of common definitions of wound infection in 4773 patients. BMJ. 2004; 329: 720-2.
14. Nichols RL. Current strategies for prevention of surgical site infections. Curr Infect Dis Rep. 2004; 6: 426-34.
15. Collier M. Recognition and management of wound infections. World Wide Wounds. (accessed 20.09.2020). (2004). Available from: https://bit.ly/1KwbFwT