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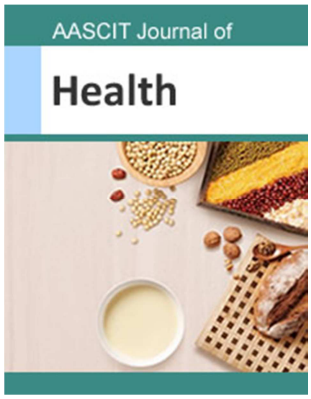

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Identification of Bacteria Associated with Wounds in Wukari and Environs, North-East, Nigeria

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Abstract
Wound is a type of injury in which skin is torn, cut or punctured and therefore compromises its protective function. The isolation and identification of bacterial from wounds was carried out on thirty (30) wound samples, which comprises of 15 (50%) males and 15 (50%) females respectively in Wukari and environs. The aim was to identify the various bacteria found on wound in these localities. These was achieved by using standard bacteriological procedures and techniques. The Result showed that majority of the wounds were contaminated with various bacteria isolates of *Staphylococcus aureus*, Coagulase negative *Staphylococcus* species and *Pseudomonas aeruginosa*. In decreasing order of frequency of occurrence of the bacteria isolates identified, *Staphylococcus aureus* 19 (62.7%), Coagulase negative *Staphylococcus* species 16 (52.8%) and *Pseudomonas aeruginosa* 7 (23.1%). In males, the isolated bacteria have high frequency of occurrence of *Staphylococcus aureus* 11 (36.3%), Coagulase negative *Staphylococcus* species 9 (29.7%) and *Pseudomonas aeruginosa* 3 (9.9%) when compared to the isolates isolated from females of which *Staphylococcus aureus* 8 (26.4%), Coagulase negative *Staphylococcus* species 7 (23.1%) and *Pseudomonas aeruginosa* 4 (13.2%). The results clearly showed *Staphylococcus aureus* as the most commonly isolated bacteria from wounds in the localities. Also, the presence of these bacteria in the various wound samples investigated could have been as a result of exposure to dirty environment, contaminated water or materials used for treatment and even from the hospital (nosocomial infections). Therefore, avoidance of these factors will help to prevent mortality, amputation and debridement of infected part of the patients or individual. In conclusion, the presence and multiplication of the above bacterial in wound, may delay the healing process of wound, therefore, whenever there is wound, especially one which delays in healing, routine culture should be carried out to determine bacterial associated with such wound and its susceptibility to various antibiotics should also be carried out to determine the choice of antibiotic for treatment. Hence good hygiene and proper care of wound infection plus in cooperation of antimicrobial drugs during treatment is advised.

1. Introduction

A wound is a type of injury which happens relatively quickly in which skin is torn, cut or punctured (an open wound or where blunt force trauma causes a contusion (a closed wound) [1]. In pathology, it specifically refers to a sharp injury which damages the dermis of the skin [2]. Wound infection is a type of injury in which skin is torn, cut or punctured and therefore compromises its protective function, as a result wound can be

contaminated by microorganisms like bacteria and infection occurs when such organisms multiplies and cause damage [3]. It is important for wound to be taken good care of, so as to promote healing, prevent infection and ideally, to achieve a good cosmetic result for the patient [1]. A delay in healing can be caused by a number of factors, both local (related to the wound itself) and systemic related to the patient and their clinical condition). Many of these factors not only delay healing but increase the likelihood of infection [4]. Contamination of wound occurs when non-replicating bacteria enters the wound [3, 4, 5]. Contamination can also occur when the bacteria begin replicating and adhere to the wound site but do not cause tissue damage [3, 6]. The healing process of the wound is not delayed by colonization alone and in some cases, colonization can enhance the healing process [7]. It can also occur when the number of bacterial is greatly increased and begins to overwhelm the host immune system [8]. During this stage, the granulation bed in the wound appears unhealthy e.g. atrophied, deep red or grey discoloration, with increased discharged but there is no sign of invasion of the surrounding tissue [7, 8, 9]. Delayed healing may be the only clinical sign when the bacteria overwhelm the patient's immune system and begin to invade and damage the surrounding tissue [4, 6, 10]. Signs and symptoms of infection occurs such as erythema, pain and purulent discharge when the infection spreads throughout the body, through the blood stream and causes systemic symptoms such as fever, chills and tachycardia [2, 11]. Specific wound features or patient factors greatly increase the risk of infection or other complications [12]. Referral for hospital assessment is then considered if a patient present with high risk features and becomes important for microbiological assessment to be carried out in the management of infected wound [13]. Information on the microbiological species present in the wound is useful for determining antibiotic choice and predicting response to treatment [11, 12, 13]. However, these results are only significant if interpreted in the context of a wound that is infected, as a non-pathogenic, colonizing bacterium will also be detected [14]. Bacterial contamination of wound is a prerequisite for infection following contamination [15]. The risk of development of wound infection will depend on several factors and the most important ones being the dose and virulence of the pathogens and host defense mechanism [16]. The risk of infection in wound is increased, if the wound is contaminated with more than 10^5 organisms per gram of tissue [17]. The dose required for infection can even be lower if a foreign body such as suture is present at the site of wound (e.g only 10^2 *Staphylococci* can cause infection in the presence of silk suture [18]. Virulence of bacteria depends on the ability to produce toxins and other substances that increase their ability to invade the host, produce tissue damage or survive within the host cells [6, 8]. For examples gram, negative bacteria contain Endotoxin or lipopolysaccharide (LPS) which is the most potent microbial mediators implicated in the pathogenesis and septic shock [6, 8, 18]. LPS triggers the release of procoagulant factors and inflammatory mediators such as cytokine which may initiate systemic inflammatory response syndrome and cause multiple system organ failure [8, 18]. Some bacterial produce polysaccharide capsule, which inhibits phagocytosis which is a critical host immune response following bacterial contamination [6, 8]. When incision is made invariably, it impairs first line of defense between the environmental microbes and internal host environment, therefore, the exposed tissue is at risk of contamination with endogenous patient's flora [19]. Exogenous contamination may also occur from operating room environments, surgical teams and instruments [2, 20]. The goal of wound infection management is to prevent or minimize the risk of infection [4, 6]. Proper hand hygiene is imperative in an effective infection control programmed; however, other precautions should also be factored as a clinic routinely working with body fluid today's wood cleaning should integrate standard precaution as a part of everyday practice [1]. Standard precautions combined universal precaution with body substances isolation and this include; Proper hand hygiene, use of gloves, use of gowns, use of masks, eye protection or face shield and safe injection practices [5, 7]. The application of this standards is determined by the healthcare worker based on the anticipated level of exposure to blood, body fluid, or pathogen exposure. Handling of contaminated medical equipment and maintaining a clean environment is also an essential part of an effective infection control programmed [1, 3, 15, 20]. To this end, this study is therefore initiated in other to determine bacteria present in different wound samples from male and female (children and adults) patients or individual by isolating and identifying them using microbiological examination procedures and to give comparison on the common bacterial found from both male and female wounds.

2. Materials and Methods

2.1. Participants/Subjects

The subjects of this investigation were males and females in Wukari and environs, ranging from children to adults who presented with wounds of different types.

2.2. Study Area

The study was carried out in Wukari town, Nigeria which lies between latitude 7°55'42" North and longitude 9°47'59" East. It has an area of 4,308 km^2 and population of over 10,000 who re mainly farmers and traders. Wukari is home to Federal University Wukari and Kwararafa University. The major languages spoken are Jukun, Kutep, Tiv, Hausa and Fulani [21]. Samples were examined in the Microbiology laboratory of the Faculty of Pure and Applied Sciences in Federal University, Wukari, North East, Nigeria.

2.3. Sample Collection and Media Used

Thirty (30) wound samples were collected aseptically, using sterile swab sticks, from both male and female individuals with wounds by rotating the sterile cotton swab stick over the wound for 5 seconds and inserted into sterile transport tube containing saline and labeled [22]. The medias used were MacConkey agar, blood agar and nutrient agar using the streak plate method.

3. Results

A total of thirty (30) wound samples fifteen (15) each were collected from both males and females. Samples were inoculated into MacConkey agar and blood agar and were then sub-cultured to nutrient agar. The results of the study are as represented in tables and figure below. Out of the 30 samples cultured, 5 had no growth while other 25 showed growth. The morphological and biochemical characteristics of each isolates are represented in table 1, the frequency and percentage number of isolates are presented in table 2, which shows *Staphylococcus aureus* as the leading isolate. Percentages distribution of isolates in both genders are represented in figure 1 and figure 2 showing in males, the isolated bacteria having high frequency of occurrence of *Staphylococcus aureus* 11 (36.3%), Coagulase negative *Staphylococcus* species 9 (29.7%) and *Pseudomonas aeruginosa* 3 (9.9%) when compared to the isolates isolated from females of which *Staphylococcus aureus* 8 (26.4%), Coagulase negative *Staphylococcus* species 7 (23.1%) and *Pseudomonas aeruginosa* 4 (13.2%).

Table 1. *Characterization and Identification of Bacterial Isolates.*

	BIOCHEMICAL TEST					
Colonial Morphology	Oxidase	Catalase	Indole	Coagulase	Motility	Gram stain
Round, milky, golden-yellow, smooth, raised and entire	Negative	Positive	Negative	Positive	Negative	Positive cocci in cluster and in pairs
Smooth, raised, entire, milky-white and creamy-yellow	Negative	Positive	Negative	Negative	Negative	Positive cocci in pairs and in clusters
Circular, bluish-green, smooth, mucoid	Positive	Positive	Negative	Negative	Positive	Negative rod

Table 1. *Continued.*

		Number of isolates in males	Number of isolates in female
Colonial Morphology	Isolates		
Round, milky, golden-yellow, smooth, raised and entire	*Staphylococcus aureus*	11	8
Smooth, raised, entire, milky-white and creamy-yellow	*Staphylococcus* Species	9	7
Circular, bluish-green, smooth, mucoid	*Pseudomonas aeruginosa*	3	4

Table 2. *Frequency and Percentage Distribution of Isolates from Male and Female Wound Samples.*

GENDER	FREQUENCY AND PERCENTAGES OF ISOLATES		
	Staphylococcus aureus	***Coagulase negative Staphylococcus* Species**	***Pseudomonas aeruginosa***
Males	11 (36.3%)	9 (29.7%)	3 (9.9%)
Female	8 (26.4%)	7 (23.1%)	4 (13.2%)
Total	19 (62.7%)	16 (52.8%)	7 (23.1%)

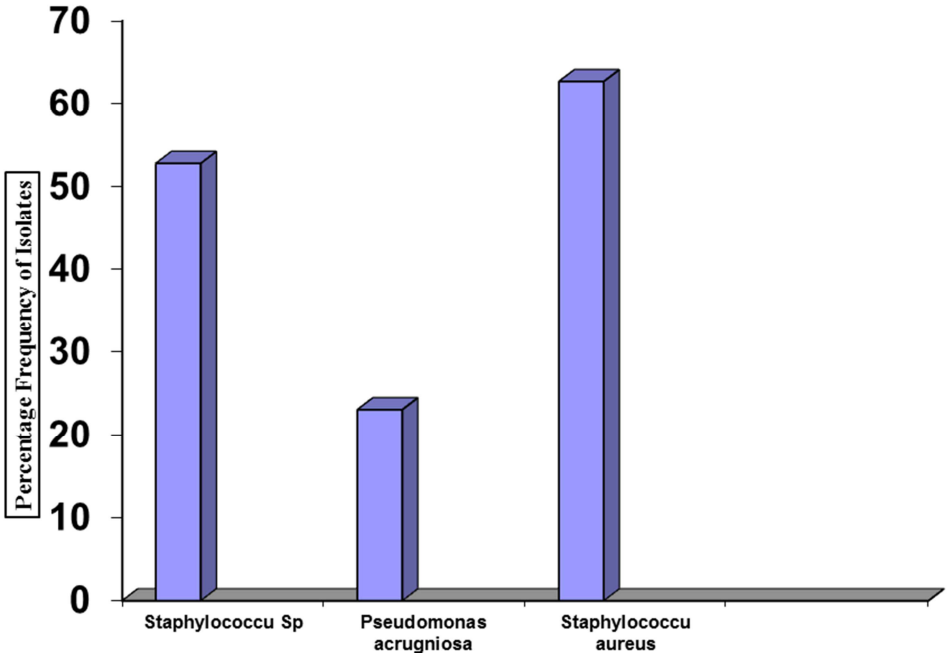

Figure 1. *Percentage Distribution of Isolates in both Male and Female Wounds.*

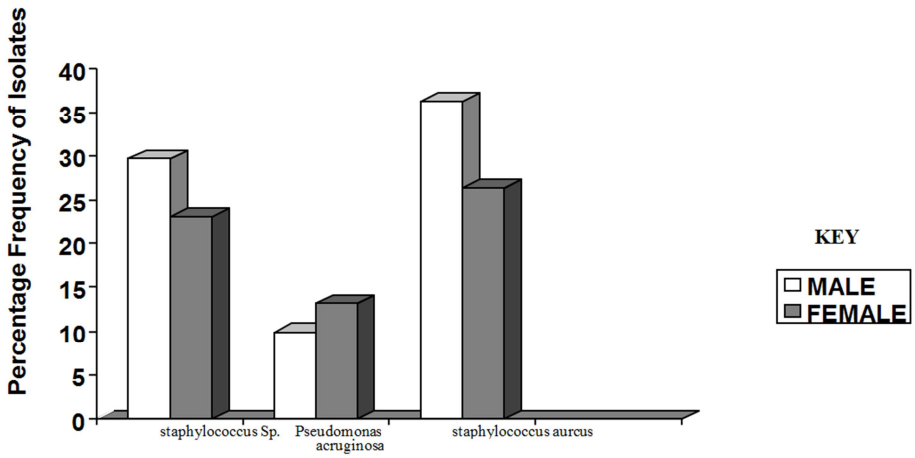

Figure 2. *Percentage Distribution of Isolates between Male and Female Wounds.*

4. Discussion

In this study, the findings demonstrate the predominance of Gram Positive *Staphylococci* species, of which *Staphylococcus aureus* was the commonest isolate, accounting for 19 (62.7%), followed by coagulase negative *Staphylococcus* species and *Pseudomonas aeruginosa* with 16 (52%) and 7 (23.1%) respectively. These results were in agreement with results from previous studies conducted globally and in various parts of the country [23]. Findings from study carried out at a university hospital in Nigeria showed that the commonly isolated bacteria were *Staphylococcus aureus* (25%) and *Pseudomonas aeruginosa* (20%) which when compared with this investigation are of lower prevalence rate [1]. A recent study at a University teaching hospital in Iran, also reported *Staphylococcus aureus* to be the commonest bacteria isolated (43%) [24]. [6, 25] postulated that the extracellular adherence protein (Eap) of *Staphylococcus aureus* played a pivotal role in impaired wound healing by impeding the inflammatory state and inhibiting angiogenesis in the proliferative state. Inflammation is an important part in wound healing and is responsible for eliminating potential pathogens [26]. However, presence of bacterial components in chronic wounds may stimulate excessive inflammatory response and chronic wounds will not heal until the excessive inflammation is reduced [27]. The distribution of these bacteria between male and female from this study showed that *Staphylococcus aureus* and coagulase negative *Staphylococcus* Species were higher in males than females with 66.3% and 49.5% respectively while *Pseudomonas aeruginosa* was higher in females than in males with 13.2% and 9.9% each. All isolates from this study were positive to catalase which nullified the presence of *Streptococcus* which incidences in wound are reported by previous investigators [27]. Most of the wounds used for this study, from these results shows that they were contaminated with these bacteria and are therefore at risk of infection, if not given proper care is not adhered to [7, 8, 10, 27].

5. Conclusion

In conclusion, *Staphylococcus aureus* was confirmed to be the most prevalent bacteria in wound from this study. Contracting wound infection remains an ongoing problem when an injury is sustained and the rate of getting infection when a wound is contaminated is greatly increased, when risk factors are present. For example, patients with diabetic are at high risk of getting infection because they have a weakened immune defense. To avoid wound infection in diabetic, one of the most importance things to do, is to practice careful foot care, in addition to wearing shoes and socks to avoid minor bumps and scrapes. the feet should be examined daily for any blisters, cuts, scrap, sore or other skin problems that could allow an infection to develop. Meticulous foot and skin care is needed to ensure that minor cuts and scrapes do not turn into ulcerated wound infections that can migrate to the blood stream and cause major problems. Routine culture should be performed whenever there is a wound and when infection develops, antimicrobial sensitivity test should be used to guide the choice of antibiotics. Strict guidelines should also be established for antibiotics prescriptions in any wound infection and above all proper hygiene most be maintain in case of an established wound infection in order to reduce if not eliminate bacterial infection completely.

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