Original Article

Wound infections secondary to snakebite

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Abstract

Background: The study was performed to identify the important bacterial pathogens responsible for wound infections secondary to snakebite and to determine their antimicrobial susceptibility.
Methodology: All cases of wound infection secondary to snakebite were included in this retrospective study. Infected tissues were surgically debrided and inoculated on blood agar and MacConkey agar for aerobic bacterial culture, followed by antimicrobial susceptibility testing of the isolates by Kirby-Bauer disk diffusion method.
Results: *Staphylococcus aureus* (32%) was the most common isolate followed by *Escherichia coli* (15%); monomicrobial infections were more frequent than polymicrobial infections. The majority of the isolates were antibiotic sensitive. Ciprofloxacin, an oral drug covering both Gram-positive and Gram-negative isolates, was the most frequently prescribed antibiotic. The patients responded well to the treatment.
Conclusion: The results of this study will be helpful in deciding the empirical antibiotic therapy in cases of wound infection secondary to snakebite in regions of Southeast Asia.

Key words: snakebite, wound infection, aerobic bacteria, antibiotics

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Introduction

Snakebite is a serious and important problem in tropical and subtropical countries. It has been estimated that five million snakebite cases occur every year, resulting in about 100,000 deaths annually worldwide [1]. On average, nearly two million persons fall prey to snakebite per year in India, resulting in 35,000 to 50,000 deaths [2]. In developing countries, snakebite is an occupational hazard for rice field workers, rubber plantation workers, herders and hunters; whereas in industrialized countries, snakes are increasingly popular as pets and most bites are inflicted when snakes are mishandled or attacked [3].

Primarily snakebites carry the consequences of envenomation leading to lesion formation at the bite site along with extensive tissue necrosis. This dead tissue can acquire secondary infection from bacteria coming from the snake's mouth inoculated at the time of the bite [3]. Until recently, very little was known about the spectrum of bacteria responsible for wound infections in snakebite patients, so in this study we have evaluated the aerobic bacteria responsible for snakebite-associated wound infections and the antibiogram of these isolates.

Materials and methods

A retrospective review of all cases of wound infections secondary to snakebite was conducted at JIPMER Hospital, Pondicherry, India, for the period January 2003 to October 2008. The diagnosis of snakebite in all the cases was confirmed by emergency department physicians. According to the hospital policy, all cases received polyvalent antivenom and tetanus toxoid, and none of the patients received prophylactic antibiotics. Sample collection from infected wounds involved thorough cleaning with 70% alcohol followed by surgical debridement; the debrided tissues were cultured for aerobic bacteria in the Microbiology laboratory. The samples were inoculated on blood agar and MacConkey agar and incubated aerobically at 37°C. Positive growth was identified by Gram stain, colony characteristics, and standard biochemical tests. Antimicrobial susceptibility testing was performed by Kirby-Bauer disk diffusion method as per CLSI guidelines [4].

Results

A total of 43 infected snakebite cases (31 male and 12 females: 86% adults) were included in this study. Twenty-four patients presented with subcutaneous abscess and 19 had localized tissue necrosis. Monomicrobial infection was present in 33 cases, whereas mixed infection by two bacteria was observed in 10 cases. Gram-positive bacteria were isolated more frequently [28/43 (52.8%)] than Gram-negative bacteria. The most common Gram-positive isolate was S*taphylococcus aureus* (n=17), followed by coagulase negative Staphylococcus (n=5) and S*treptococcus spp.* (n=6). Among Gram-negative bacilli, members of Enterobacteriaceae were most frequent isolates followed by non-fermenters (*Pseudomonas spp. and Acinetobacter spp.*) (Table1). The *Staphylococcus aureus* strains showed 100% sensitivity to vancomycin and > 88% sensitivity to oxacillin, amikacin, and ciprofloxacin. However, penicillin resistance was observed in 53% of *Staphylococcus aureus*. Most of the Streptococcal isolates were sensitive to commonly tested antibiotics. Gram negative bacilli showed > 85% sensitivity to aminoglycosides, third generation cephalosporins, and ciprofloxacin. None of the isolates was resistant to meropenem. Ciprofloxacin was the most frequently prescribed antibiotic with good response. The patients responded well to the treatment.

Table 1. Bacteria isolated from infected wounds following snakebite

Bacteria isolated (n=53)	**Number**
Gram-positive bacteria (n=28)	
Staphylococcus aureus	17
Coagulase negative staphylococcus	5
Enterococcus faecalis	4
Streptococcus spp	2
Gram-negative bacteria (n=25)	
Escherichia coli	8
Klebsiella pneumoniae	4
Proteus spp.	3
Morganella morganii	3
Pseudomonas aeruginosa	3
Acinetobacter spp	2
Enterobacter spp	2

Discussion

The oral flora of snake comprises a wide range of aerobic and anaerobic micro-organisms, especially the fecal Gram-negative rods, because their prey usually defecate while being ingested.[5] Culture of fangs, fang sheaths, and venom of various snakes such as bothrops, vipers, rattlesnakes and naja naja, have shown heavy colonization with many bacteria, including members of Enterobacteriaceae including *Morganella spp.* and *Escherichia coli*, Group D streptococci, *Aeromonas spp*., and anaerobes such as *Clostridium spp*. [5,6,7].

Soft tissue infections are a major complication of snakebite with local envenoming. The proteolytic properties of snake venom cause extensive tissue destruction and devitalization, thus predisposing the wound to bacterial infection from the snake's indigenous oral flora [5]. Although bacteria are a major cause of wound infection in snakebite patients, the role of prophylactic antibiotics to prevent their formation is debatable [8]. A retrospective study from Zimbabwe involving cases of cellulitis secondary to snakebite demonstrated that prophylactically the most frequently used antibiotics were drugs in the penicillin family [1]. Another study from southern Africa suggested that if antibiotics are to be used empirically in patients with snakebite, then members of *Staphylococcus spp.* and Gram-negative bacteria such as Enterobacteriaceae must be covered [9]. Studies from Saudi Arabia and Eastern Ecuador have reported that ampicillin alone or in combination with another antibiotic were most commonly used for management of snakebites [10,11]. However, the spectrum of bacteria from the venom and oral cavities of snakes vary with geographic area as well as with the species and the oral health of the snake, and these factors cannot easily be extrapolated to snakes in rest of the world. In our study, the antibiogram showed that the majority of isolates were sensitive to commonly tested antibiotics such as gentamicin, amikacin, ciprofloxacin, ceftriaxone and meropenem. Ciprofloxacin, an oral drug effective against both Gram-positive and Gram-negative isolates, was most frequently prescribed to patients who developed wound infections. The patients responded well to this treatment.

It is difficult to perform bacterial culture and antimicrobial susceptibility for every patient of snakebite, particularly for those living in rural and tribal areas; hence regional studies are required to identify the spectrum of bacteria and their antibiotic susceptibility pattern. This study performed in India will be helpful in determining the empirical antibiotics to be used in cases of snakebite wound infection in Southeast Asian countries. However, it is strongly suggested that clinical specimens for culture should be collected before commencing antibiotic therapy for cases of snakebite associated with cellulitis, abscess, gangrene or bulla,.

The major limitation of this study is that anaerobic culture was not performed. In addition, the prevalence of patients who developed wound infection secondary to snakebite could not be calculated as only those with wound infection were studied. Several other reports have documented a low incidence of wound infection after snakebite and have failed to show clinical evidence of the benefit of prophylactic use of antibiotics 10.12]. In view of the above findings, in our institute routine antibiotic prophylaxis is not practiced for all cases of snakebite, and broad-spectrum antibiotics such as ciprofloxacin are used only when there is clinical evidence of infection.

In conclusion, according to our findings, ciprofloxacin should be used empirically in patients who develop wound infection secondary to snakebite in countries in Southeast Asia. Further prospective multicentric studies involving large geographical areas are warranted to study the development of wound infections in snakebite cases.

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