Dog Bites in Humans: Current Insights into Causative Microorganisms and Associated Infections

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Abstract

Introduction: Although dogs are considered humans' best friends, they often bite and cause wounds that may become complicated with life-threatening infections. Various Gram-positive and Gram-negative microorganisms can lead to conditions such as sepsis, septic shock, multiorgan failure, tetanus, rabies, and others. The cornerstone of management is appropriate wound care, immunoprophylaxis, and treatment with selected antibiotics and other necessary symptomatic therapies.

Methods: A review of the literature was conducted to identify studies addressing the microbial agents, infectious syndromes or nosologies caused by dog bites, and the antibiotic and immunoprophylactic measures aimed at preventing secondary infectious complications. Diagnostic and therapeutic approaches in these patients were also evaluated, as well as the role of clinical microbiology laboratories in isolating microorganisms from wound or blood cultures.

Results: Dog bites carry a significant risk of infectious diseases such as tetanus and rabies. Despite the availability of vaccination, tetanus remains a global threat and a serious public health issue in our country, with mortality rates reaching up to 40%. These patients may also present with clinical manifestations of meningitis, endocarditis, fasciitis, septic arthritis, osteomyelitis, and other conditions caused by diverse microbial pathogens.

Conclusions: Dog bites are common incidents worldwide and in our region, leading to physical impairment, psychological trauma, secondary wound infections, and potentially life-threatening infectious diseases, as well as considerable economic costs. Proper and timely management of these patients requires strong and professional interdisciplinary collaboration.

***Keywords**: dog bite wound, bite, microorganisms, immunization status, antibiotic therapy, tetanus vaccination, epidemiology, treatment.*

Introduction

Dogs, often called humankind's four-legged friends, trace their origins back more than 100,000 years.[1] They are believed to be the first animal domesticated by humans around 10,000 years ago, leading to a long history of coexistence. Both domestic and wild or stray dogs constitute a global population of approximately 900 million.[2] Dogs make the world a better place, performing multiple roles within human society — as companions, aids to people with disabilities, and partners of law enforcement agencies, among others.[3] As Victor Hugo once said, "Look into the eyes of a dog and try again to assert that animals have no soul."

However, when provoked or frightened, dogs may react defensively and bite. Those at risk of dog bites include children, adults, the elderly, and specific occupational groups such as veterinarians, animal handlers, and agricultural workers. The lifetime probability of experiencing a dog bite is estimated at around 50%, and dog bite injuries account for approximately 1% of all emergency department visits.[4] These bites often lead to infections ranging from mild to life-threatening.

The routes of infection include direct inoculation of microorganisms into the damaged skin or tissues, secondary superinfection, or transmission through food

or close contact with the dog. The most common causative agents are Pasteurella multocida, Capnocytophaga canimorsus, Streptococcus species, Staphylococcus species, Bergeyella zoohelcum, and Alcaligenes faecalis, among others.

Local bacterial infections typically manifest with redness, swelling, and pain at the bite site and may progress to cellulitis, abscess formation, septic arthritis, or fasciitis. Systemic infections may include sepsis, septic shock, and multiorgan failure. These severe forms are more frequently observed in high-risk groups such as the elderly (due to reduced immunity and increased dog ownership), and individuals with asplenia, diabetes, cirrhosis, or chronic alcoholism.[5][6][7]

Post–dog bite management consists of meticulous wound care, the use of appropriate antibiotics and supportive symptomatic therapy, and the application of immunoprophylaxis — including administration of tetanus antitoxin (particularly in those not up to date with vaccination) and anti-rabies serum when indicated.

Methods

A literature review was conducted to identify studies addressing the microbial agents and infectious syndromes or nosologies caused by dog bites. We also identified studies discussing antibiotic and immunoprophylactic strategies aimed at minimizing subsequent infectious complications. A summary of the literature on the diagnosis and treatment of infections in patients with dog bite wounds was presented. Furthermore, we evaluated the work of clinical microbiology laboratories that facilitate the isolation of microorganisms obtained from wound, blood, and other relevant cultures.

Results

Even a seemingly minor dog bite can lead to severe and potentially fatal infection. Dog bite wounds account for approximately 250,000 visits to emergency and urgent care units each year.[8] Pasteurella canis is the most common microorganism isolated following dog bites, although other aerobic bacteria (Streptococcus, Staphylococcus, Moraxella, Neisseria) and anaerobes (Fusobacterium, Bacteroides tectum, Porphyromonas, Prevotella heparinolytica) are also frequently involved. [9] Initially, local infection manifests as cellulitis or abscess formation resulting from soft tissue injury, laceration, microbial contamination, or secondary superinfection.[10][11]

Sepsis and fulminant sepsis can develop even in individuals without evident bite marks, scratches, or open wounds. Capnocytophaga canimorsus — a Gram-negative, facultative anaerobic bacterium that colonizes the oral cavity of dogs — is

recognized as one of the leading causes of fulminant sepsis, with a high mortality rate (26–60% following bites and approximately 24% after scratches, close contact, or licking).[12][13] Without prompt and professional intervention, sepsis may rapidly progress to septic shock, disseminated intravascular coagulation, multiorgan failure, and death.

Jun et al. reported the case of a 46-year-old man who, three months after a dog bite, developed infective endocarditis of the aortic valve caused by C. canimorsus.[14] Such patients may also develop meningitis, endocarditis, pneumonia, or osteomyelitis.[15] These clinical manifestations may also be due to fungal microorganisms; therefore, in patients unresponsive to appropriate antibiotic therapy, fungal etiology should be considered.[16] Bergeyella zoohelcum, an aerobic Gram-negative bacterium, has been implicated particularly in pediatric infectious complications.[17][18]

Albania, as a Mediterranean country with diverse flora and fauna, provides an environment that facilitates close human–dog contact. In our country, dog bite victims have included cases that developed infectious diseases such as rabies and tetanus. One notable historical episode occurred in Kaçinar in 1976, when 60.8% of dog bite victims developed rabies — manifesting as encephalitic or paralytic forms — and all of them died.[19] Tetanus remains, as globally, a serious public health concern in Albania. Pilaca et al., in a study of 64 hospitalized patients in Tirana, Shkodra, and Korça, reported a mortality rate of 38.6%, most frequently among the elderly, in those with incubation periods shorter than 11 days, and in patients with infected wounds.[20]

It is therefore essential to evaluate wounds with tetanus potential to appropriately apply immunotherapy (serum and vaccine) and prevent the occurrence of tetanus — a life-threatening infection caused by Clostridium tetani. During diagnosis, the patient's medical history and comorbidities should be carefully considered, as these may adversely affect prognosis. Reliable information on the patient's vaccination record (particularly regarding tetanus) is crucial, as well as data on the geographical site of exposure and the type of dog involved (especially concerning rabies risk). Additional diagnostic evaluations including laboratory, microbiological, serological, and imaging studies are of great importance. Microbiological diagnosis is based on identifying the causative pathogens in clinical microbiology laboratories from cultures obtained from the wound, tissue, or blood.

The cornerstone of management remains proper wound care (thorough cleaning and debridement), antibiotic use to reduce the risk of secondary infections, and immunoprophylaxis (serum and vaccination). The "golden key" is timely antibiotic prophylaxis.[21] Treatment is often empirical; combinations such as imipenem/cilastatin, clindamycin, or beta-lactamase inhibitors are consistently effective and may be recommended for all types of infection.[22][23]

Nevertheless, dogs bring such joy to our lives that it is difficult to imagine life without them — a reminder that we must care for them responsibly, while also safeguarding our own health.

Conclusion

Stray dogs, often aggressive, remain a serious concern for local residents — including children, adults, and the elderly — as well as for the growing number of foreign tourists, given that Albania has become a popular tourist destination. Dog bites are common occurrences both globally and locally, leading to consequences such as physical injury, psychological trauma, wound superinfection, and potentially life-threatening infectious complications including sepsis, tetanus, and rabies, in addition to the economic costs of disability and treatment.

Proper and timely management of these patients requires strong and professional interdisciplinary collaboration.

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