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ANIMALS AND HUMAN BITES: RISKES AND FIRST AID MEASURES

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Abstract

Animal bites are common worldwide and may be associated with significant morbidity. Biting is a common zoological behavior involving the active, rapid closing of the jaw around an object. A behavior is found in toothed animals as mammals, reptiles, amphibians, and fish, but can also exist in arthropods. Besides, human biting is an age appropriate behavior and reaction for human children 30 months and younger. Conversely, children are expected to have verbal skills to explain their needs and dislikes, biting is not seen as age appropriate. Biting may be prevented by methods including redirection, change in environment and responding to biting by talking about appropriate ways to express anger and frustration. Preschool and schoolaged children, those older than 30 months, who habitually bite may require professional intervention,

Key words: Man, Dogs, Cats, Bites, Pathogenicity, Initial management, Overview

Introduction

Animal and human bites are a common public health problem worldwide (Jaffe, 1983). Proper care requires wound inspection for injury to deeper structures; meticulous wound care at the initial encounter; and decisions regarding primary closure, provision of prophylactic antibiotics for wounds at high infection risk, and tetanus and rabies prophylaxis were a must (Byrington and Basow, 2009).

Review and Discussion

Epidemiology: Animal bites are common. In the United States, there is an annual incidence of two to five million occurrences that account for about 1% of all visits to emergency departments (Wiley, 1990). More than one million victims of bites seek medical attention; medical costs for dog bites alone are estimated at $4165 million annually (Goldstein, 1989). The vast majority of mammalian bites are inflicted by dogs (60 to 90%), with remainder caused by cats (5 to 20%), rodents (2 to 3%), humans (2 to 3%), and rarely, others as rodent, horse, donkey, mule....

Approximately 10% of bite wounds presenting for medical attention require suturing and follow-up care, and 1 to 2% result in hospitalization (Oehler *et al,* 2009). Animal bites cause 10 to 20 deaths annually in USA, primarily among infants and small children. The extensive morbidity, including disability and cosmetic damage, can also result from infection (Hodge and Tecklenburg, 2006).

Epidemiology differs between dog and cat bites: 1- Dog bites: Dog bites are frequently caused by animals known to the victim. This was demonstrated in a large observational study that described dog bite wounds sustained by children who were treated in an Austrian Pediatric Trauma Center. The dog was familiar to the child in 82% of cases. German Shepherds were responsible for at least 34% of bites, although breed comprised only 12% of the local dog population. Also, in Austria male dogs (50%) and certain breeds of dog (e.g., German Shepherds, Pit Bull Terriers) were more commonly associated with bites to the face, head, and neck of <17 years old children (Schalamon *et al,* 2006). Dog bites to the head and neck occur in 60 to 70% of attacks in children below five years age and in 50% of those 5 to 10 years old, presumably because of the proximity of the young child's head to the mouth level in a large dog and their uninhibited behavior around dogs (Patronek and Slavinski, 2009). The predominant pathogens in animal bite wounds are the oral flora of the biting animal and human skin flora (Talan *et al,* 1999)

About 85% of bites harbor potential pathogens, and average wound yields 5 types of bacterial isolates; 60% have mixed aerobic and anaerobic (Goldstein *et al,* 1978).

2- Cat bites: Cat bites are bites inflicted upon humans, other cats, and other animals by the domestic cat or *Felis catus* (Wozencraft, 2005). Cat bites are usually considered minor injuries with their teeth or claws but can result in serious infection (Maniscalco and Edens, 2017). Common symptoms include pain and swelling around the affected area (Aziz *et al,* 2015). Sometimes, direct tissue damage bite can impair mobility or cause tenosynovitis or arthritis (Westling *et al,* 2006). But, unusual complications occurred as deep-vein thrombosis (Guadarrama-Conzuelo and Gutierrez-Castillo, 2019), subcutaneous emphysema and fetal tachycardia (Wagner *et al,* 2006). In contrast to dog bites, which often occur in males and children without overt provocation, females and adults are more commonly bitten by cats; 89%of these bites are provoked (Patrick and O'Rourke, 1998).

Microbiology: The predominant pathogens in animal bite wounds are oral flora of the biting animal and human skin flora. Infection usually results from a mixture of organisms. Common pathogens (in order of prevalence) include *Pasteurella* species, staphylococci, streptococci, anaerobic bacteria and *Capnocytophaga canimorsus* that cause fatal sepsis especially in asplenic patients, chronic alcohol abusers, or those with underlying hepatic disease (Philipsen *et al,* 2006). Cat bites also transmit *Bartonella henselae* that cause cat scratch disease and most cats and kittens are infective for mouths without any symptoms (Rijks *et al,* 2016). Scratching may be contaminated with *Ancylostoma tubaeforme, A. braziliense, Uncinaria stenocephala,* and *Capnocytophaga canimorsus* (Zajkowska *et al,* 2016). Risk factors for *C. canimorsus* infection include a history of a dog bite (occasionally cats) and immunocompromise, particularly asplenia, functional asplenia, cirrhosis, or a history of heavy alcoholism with a rate up to 74% in men with a peak of 50 to 70 years old (van Dam and Jansz, 2011). Rabies is a virus fatal neurologic disease in animals and man commonly caused by bites from rabid animals (96% dog). Infected cats may have a variety of signs, but have sudden behavioral changes and progressive paralysis (Chatterjee, 2009).

Pathogens involved in human bite wound infections usually reflect normal human mouth and skin flora. Types of organisms recovered differ among animal bites (Daniels *et al,* 2009): a- *P. multocida* is a rare isolate, b- *Eikenella corrodens*, a gram-negative anaerobe, is a common constituent of normal human mouth flora and is recovered from seven to 29% of human bite wounds but rarely from animal bites, & c- Aerobic gram-positive cocci (e.g., Group A Streptococcus) and anaerobes are found more frequently in bites from humans rather than other animals (Dusheiko *et al,* 1990). Human bite wound pathogens include aerobic bacteria (such as streptococci and *S. aureus*) and anaerobic bacteria such as *Eikenella, Fusobacterium, Peptostreptococcus, Prevotella,* and *Porphyromonas* spp. (Vidmar *et al,* 1996). Among 50 patients with infected human bites, average number of isolates per wound culture was four (Bartholomew and Jones, 2006). Both aerobes and anaerobes were isolated from 54% of wounds, aerobes alone were isolated from 44%, and anaerobes alone were isolated from 2% (Talan *et al,* 2003).

Viral pathogens as hepatitis (B & C), and *Herpes simplex* virus were transmitted by human bites (Figueiredo *et al,* 1994), and human immunodeficiency mainly the HIV-1 (Vidmar *et al,* 1996). Also, human bite can transmit syphilis (Oh *et al,* 2008).

Clinical manifestations: The typical location and nature of the injury differs depending upon the animal inflicting the bite:

Dog bites: Dog bites cause a range of injuries from minor wounds (e.g., scratches, abrasions) to major complicated wounds such as the deep open lacerations, deep puncture wounds, tissue avulsions and crush injuries

(Goldstein, 1992). The jaws of large dogs can exert a strong force that may inflict serious injury. Lethal injuries, although rare, usually involve the head and neck, or direct penetration of vital organs in young children (De Munnynck and Van de Voorde, 2002). The extremities, particularly the dominant hand, are the most frequent site of injury when youth or adults were bitten by a dog (Brogan *et al,* 1995).

Cat bites: Two-thirds of cat bites involve the upper extremities; scratches typically occur on the upper extremities or face. Deep puncture wounds are of particular concern because cats have long, slender, sharp teeth. When hand is the target of such a puncture wound, bacteria can be inoculated below periosteum or into a joint and result in osteomyelitis or septic arthritis (Goergens *et al,* 2009). Chodakewitz and Bia, 1988).

Human bites: Human bites can be as dangerous as or even more dangerous than animal bites because of the types of bacteria and viruses contained in the human mouth. Human bites that break the skin can become infected. If someone cuts his or her knuckles on another person's teeth, as might happen in a fight and considered a human bite (Kermott and Millman, 2017). Human bite injuries carry the risk of being infected with the oral cavity bacteria flora (Di Benedelto *et al,* 1999). When a patient is bitten by a man, a semicircular or oval area of erythema or bruising is usually visible; the skin itself may or may not be intact (Goldwin *et al,* 1999).

1- Pediatric wounds: In young children, human bites are typically located on face, upper extremities, or trunk. They frequently occur as the result of aggressive play with another child who inflicts the bite. These wounds may not break the skin and are often trivial. But, if a bite mark has an intercanine distance greater than three centimeters, the bite probably came from an adult and should raise concerns about child abuse (Prescott, 1984).

Physical child abuse may be broadly defined as serious injury inflicted upon a child by a parent or caretaker. Specific definitions vary widely among countries, among different ethnic and religious groups (Dubowitz and Bennett, 2007). The four major types of child abuse are physical abuse, sexual abuse, emotional abuse, and child neglect defines child abuse as any immediate act or failure to act (Gilbert *et al,* 2009). Resulting in death, serious physical or emotional harm, sexual abuse, or exploitation; or imminent risk was the serious harm (Gilbert *et al,* 2012). The commonest perpetrators of physical abuse, in descending order of frequency, were fathers, mothers' boyfriends, female babysitters, and mothers (Brook, 1981). Parental risk factors for abuse include young or single parents, parents with lower levels of education, and bad family situations. Parents who abuse their children often were abused or neglected themselves as children, leading to abuse or neglect of their own children as a learned behavior (Kellogg and Lukefahr, 2005). However, self-inflicted bites occurred from nail-biting and thumb-sucking but can also be associated with psychiatric illness or metabolic disease. Occasionally, paronychia in infants resulted from a parent biting rather than cutting child's nails (Schweich and Fleisher, 1985).

Clenched fist injury: Human bites in adolescents and adults frequently present with small wounds overlying the metacarpophalangeal joints; such wounds arise from a fist fight when the individual throwing a punch with a clenched fist meets the teeth of another person. Skin breaks over the knuckles can lead to the introduction of both skin and oral flora into fascia layers of the hand with potential spread to the nearby joint (Phair and Quinton, 1989). The lacerations typically occur over third and fourth metacarpophalangeal or proximal interphalangeal joints of the dominant hand. Although they are usually quite small (up to 15mm), they are highly prone to infection given the proximity of the skin over the knuckles to the joint capsule. Relaxation of the fist-bump may carry micro-organisms in the deep compartme-

nts and the deep tendon spaces of the hand. Thus, patients with such injuries are at risk for deep soft tissue infection, septic arthritis, and osteomyelitis (Moran and Talan, 1993).

Many patients ignore these wounds until the onset of pain, swelling or purulent discharge; as a result, these injuries are often complicated by established infection at the time patients seek medical attention. Predominant pathogens in animal bite wounds are the oral flora of the biting animal and human skin flora (Talan *et al,* 1999). About 85% of bites harbored potential pathogens, and average wound yielded five types of bacterial isolates that were 60% mixed aerobic and anaerobic bacteria (Goldstein *et al,* 1978).

2- In human bites, approximately 10%-15% of wounds become infected owing to multiple factors. The bacterial inoculum of human bite wounds contains as many as 100 million organisms per milliliter and is made up of as many as 190 different species. Many of these are anaerobes that flourish in the low redox environment of tartar that lies between human teeth or in areas of gingivitis (Stevens *et al,* 2014). Although the incidence of domestic animal bites is showing an increasing trend, it seems to have been underestimated because not all patients visit the hospital (Benson *et al,* 2006).

Bites to the breasts and genitals may occur during sexual activity or sexual assault. The pattern of injuries sustained during a sexual assault may show considerable variation. This may range from a complete absence of injuries (most frequently) to fatal injuries (very rare). In caring for victims of sexual violence the overriding priority must always be the health and well-being of the patient

Infected wound: Clinical manifestations of bite wounds may include fever, erythema, swelling, tenderness, purulent drainage and lymphangitis. Complications are sub-cutaneous abscesses, osteomyelitis, septic arthritis, abscesses, osteomyelitis, septic arthritis, tendonitis, and bacteremia (Brook, 1989).

Infection with *P. multocida* characteristically develops rapidly following the cat or dog bites with erythema, swelling, and intense pain evident as early as 12 to 24 hours after bite. Systemic signs of infection, such as fever and lymphadenopathy, are infrequent. Localized cellulitis caused by this organism can be subacute in onset, beginning 24 to 72 hours after injury; systemic infection occurs in less than 20% of the cases, but may involve bone, joints, blood, and meninges (Klein and Cohen, 1978). Plague is a murine zoonosis; humans are incidental hosts, and acquire plague via rodent fleas bites, scratches or bites from infected domestic cats, direct handling of infected animal tissues, inhalation of respiratory secretions from infected animals, aerosolized droplets inhalation from infected humans, consumption of contaminated food, or by laboratory exposure (CDC, 1994). Cats are highly susceptible to plague as common source of *Yersinia pestis* infection to humans (owners and veterinarians). Dogs infected with plague are less likely to develop clinical illness than cats (CDC, 2020). El Bahnasawy *et al.* (2012) in Egypt mentioned that there are three major clinical syndromes associated with plague, bubonic plague (80 to 95%), septicemic plague (10 to 20%), and pneumonic plague generally rare, and the clinical pictures of plague vary with the type of disease, with incubation period generally two to eight days. They added that man acquire plague by: 1- Bites by rodent fleas, 2- Exposure to pneumonic plague, 3- Handling of infected animal carcasses, 4- Scratches or bites from infected pet cats, and 5- Exposure to aerosols. In India, an overall estimated mortality was 60 to 100% in untreated plague compared with less than 15% with treatment (Campbell and Hughes 1995). A delay in treatment from the time of bite injury is one of several factors that can affect the incidence of infection following dog or cat bites (Blackburn *et al,* 2013).

Tularemia is a zoonotic infection caused by *Francisella tularensis*, an aerobic and fastidious gram-negative bacteria. Human infection occurs following contact with infect-

ed cats, dogs, rabbits, hares, and muskrats or insect-vectors (Morsy *et al,* 2001). Synonyms include Francis' disease, deer-fly fever, rabbit fever, water-rat trappers' disease, wild hare disease (yato-byo), and Ohara's disease (Yaqub *et al,* 2004). Patients who wait more than 24 hours after injury to seek medical attention have probably developed infection and are often seeking care for infectious signs or symptoms rather than evaluation of an uninfected wound.

Laboratory examinations: Aerobic and anaerobic blood cultures are warranted before antibiotic therapy in patients with an infected bite wound and signs of systemic infection. A complete white blood cell count, C-reactive protein, & erythrocyte sedimentation rate may be elevated in patients with cellulitis, joint infection, osteomyelitis, or sepsis, but normal values didn't rule out infections (Karwowska *et al,* 1998). Oehler *et al.* (2009) in USA reported that contained a mix of anaerobes and aerobes from patient's skin and animal's oral cavity, including species of *Pasteurella, Streptococcus, Fusobacterium,* and *Capnocytophaga*. They added that bite wounds can produce substantial morbidity by complicated by disseminated sepsis particularly by *C. canimorsus* and *P. multocida* leading to septic shock, meningitis, endocarditis, and other severe sequelae.

Wound culture: Wound cultures of uninfected bite wounds are not useful. If a bite wound appears to be infected, Gram stain and aerobic and anaerobic cultures should be obtained prior to the initiation of antibiotics (Boenning *et al,* 1983). Laboratory requisition should be cultured source for *E. corrodens* (human bites) and *P. multocida* (dog and cat bites) are fastidious organisms and are often misidentified. Wound cultures didn't indicate in clinically uninfected bite wounds as results didn't correlate with likelihood of infection or pathogens present in the patients with subsequent infection (Callaham, 1980).

Plain radiographs and ultrasound: Deep bite wounds near joints warrant AP and lateral plain radiographs to evaluate for disruption of bone or joints and evidence of foreign bodies, such as embedded teeth. Plain radiographs are also indicated in markedly infected wounds to detect bony and soft tissue injury, subcutaneous gas, and changes associated with osteomyelitis. Ultrasound may be helpful to identify abscess formation and locating radiolucent foreign bodies in the infected wounds (Sutton and Alpert, 1984).

Head computed tomography: Dog bites to head occasionally penetrate the skull. A depressed skull fracture, local infection, and/or brain abscess may result. Thus, a head computed tomographic (CT) scan is warranted in patients with a deep dog bite to the scalp, including puncture wounds, especially in infants < 2 years of age (Iannelli and Lupi, 2005). The following radiographic findings indicate a penetrating injury: 1- Fracture, 2- Puncture through the outer plate of skull, & 3- Free air in the cranial vault.

Initial management or stabilization: Direct pressure should be applied to actively bleeding wounds and a neurovascular assessment should be performed in areas distal to the wound. Deep wounds to vital structures should be treated as major penetrating trauma. (Children have less fat, more elastic connective tissue, and a pliable skeleton protecting tightly packed abdominal and thoracic structures. The force of an impact is transmitted widely through a child's body, resulting in multisystem injuries in almost 50% of children with serious trauma, as they have larger body surface area to body mass ratio predisposes them to larger heat and insensible fluid loss than adults, resulting in higher fluid and caloric requirements (Stafford *et al,* 2002).

Avarello and Cantor (2007) in USA added that the children physiological response differed to major trauma compared to adults, in that they maintain a near-normal blood pressure even in the face of 25% to 30% of blood volume loss. In these situations, subtle changes in the heart rate and extremity perfusion may signal impending cardiorespiratory failure, and should not be overlooked.

Consequently, the decision of whether the injured child must be transferred to a trauma center or to nearest available facility mainly depends on the geographic location and local policies.

Wound preparation: Meticulous wound care constitutes one of the most important steps in treating a laceration due to an animal or human bite. It is less clear how much wound preparation reduces the risk of infection after puncture wounds. Appropriate local anesthesia facilitates adequate wound cleansing. Chen and Cunningham (2001) reported that topical anesthetics were important increasingly, as the outpatient number surgeries for dermatologic problems in infants and children steadily growing. This noninvasive anesthetic modality delivery in conjunction with a reassuring environment may minimize the discomfort of otherwise painful procedures. Since 1880s, when cocaine was first used as a topical ophthalmologic anesthetic, many ester-and amide-based local anesthetics were developed for a variety of simple and complex procedures. Pediatric dermatologist's arsenal of topical anesthetic preparations is increasing with the development of novel vehicles of transdermal delivery & the anesthetics in combination. Joshi *et al.* (2016) in USA reported that meticulous, systematic, and extensive surgical site local anesthetic infiltration in the various tissue planes including the peritoneal, musculofascial, and subdermal tissues, where pain foci originate, provides excellent postoperative pain relief. Approach should be combined with other nonopioid analgesics with opioids reserved for rescue, and designed assess analgesic efficacy of proposed infiltration technique.

To reduce the bacterial counts in wound surface must be cleaned with povidone iodine 1% or benzalkonium chloride 1%, and depths irrigated with copious amounts of saline using pressure irrigation. Debridement of devitalized tissue is important to remove any nidus for infection. Crowley *et al.* (2007) in UK reported that the first step in management of any traumatic wound is thorough irrigation, which serves to clean the wound and facilitate complete inspection. Sterile saline is the solution of choice due to ready availability and its isotonic nature, although studies show no difference in outcomes when using saline versus water or additives to fluids. They added that irrigation volume must be sufficient to clear all debris from the wound and to decrease bacterial load. Animal models demonstrated that greater volumes remove more bacteria, and that greater volumes achieved similar bacteria-reducing results when using low pressure versus pressurized irrigation systems.

Once anesthetized, wound should be carefully explored to identify injury to underlying structures and possible presence of a foreign body. Wounds over or near metacarpophalangeal joints must be explored carefully in the anatomical and clenched-fist position to assess for damage to underlying tendon sheath, fascia, joint capsule, and metacarpal head. If a potentially deep bite occurs, near a bone or if a foreign body was present, appropriate imaging must be obtained as plain radiograph or ultrasound (Goldstein, 1998).

Puncture wounds: Puncture wounds present significant challenges to wound care. No wound treatment method has been proven to effectively reduce contamination or subsequent infection of these wounds. Most study involves the care of plantar puncture wounds caused by stepping on a sharp object rather than puncture wounds caused by bites.

The following was based upon clinical experience and biologic reasoning (Chisholm and Schlesser, 1989): 1- Trim any superficial devitalized epidermal tissue, 2- Inspect the wound for evidence of deep puncture, especially if the wound is located in the scalp or near a joint, 3- Remove any foreign bodies or gross wound contaminants, 4- Superficially irrigate wound, avoiding high pressure irrigation into wound, & 5- Avoid removal of deep tissue (e.g., coring). Efficacy of soaking puncture wounds in an antiseptic (e.g., Povidone iodine 1%) is controversial.

Some experts suggested that it promotes wound cleansing, others avoid this approach because of potential to delay wound healing, but Halaas (2007) suggested soaking puncture wounds in an antiseptic solution for 15 minutes after the above steps are performed.

Primary closure: Approach to wound closure varies in part with the type of bite. A clinician with prior training and experience in laceration repair may perform primary wound closure of simple lacerations due to dog bites. In contrast, most cat or human bites are left open to heal by secondary intention. However, when cosmetic is paramount (e.g., facial lacerations), the expert clinician may choose to repair these wounds as well. In addition to these indications for primary wound closure of open lacerations, laceration meets the following criteria: 1- Clinically uninfected, 2- Less than 12hours old (24hrs on face), & 3- Not located on hand or foot

In particular, wounds to the face are usually closed promptly because good cosmetic is es-pecially important, and infection of such wo-unds is uncommon, perhaps due to the excellent blood supply to the face and scalp. Leaper and Edmiston (2017) in UK reported that subcutaneous sutures must be used sparingly, since foreign material in a contaminated wound increases the risk of infection. They concluded that despite a growing consensus that biofilms contribute to delay in chronic wounds healing of, conflicting evidence pertaining to their identification and management can lead to uncertainty regarding treatment.

Provision of proper wound care is essential to good outcomes and to reduce infection risk in patients underwent wound closure. When bite wounds are sutured, extensive irrigation, debridement, avoidance of deep sutures (if possible), institution of prophylactic antibiotics, and close follow-up are indicated. But, sealing the wound with cyanoacrylate tissue adhesive ("glue") should be avoided. Wounds at high risk for the development of infection should not be closed primarily in most cases. These include (Kannikeswaran and Kamat, 2009): 1- Crush injuries, 2- Puncture wounds, 3- Bites involving the hands and feet, 4- Wounds more than 12hrs old (24hrs old on face), 5- Cat or human bites, except those to face, & 6- Bite wounds in compromised hosts such as immunocompromised without spleen or splenic dysfunction, venous stasis, & adults diabetes mellitus. Wounds should be irrigated copiously, dressed, left open to drain, and examined daily to detect signs of infection.

Risk of infection: Two studies have addressed the risk of infection following primary closure of bite wounds: 1- In a quasirandomized trial of 96 patients with 169 dog bites, 92 were closed and 77 left open after debridement and irrigation; prophylactic antibiotics were not given (Maimaris and Quinton, 1988). Thirteen wounds developed infection; rate did not differ based upon whether the wound was sutured or remained open (7.6 vs. 7.8%), & 2- A study assessed wound infection in 145 bites closed primarily: 88 bites were inflicted by dogs, 45 by cats, and 12 by humans. Majority of wounds (57%) were on head and neck, eight patients (5.5%) developed infection despite having antibiotics at 2hrs post-injury (Chen *et al,* 2000).

Delayed primary closure: Some physicians choose to leave bite wounds open for drainage and possible delayed primary closure 72hrs after injury (Fleisher, 1999). Wound cleansing and debridement of devitalized tissue should still occur during initial care, and the wound should be dressed with wet saline dressings twice daily until closure. Ruifeng *et al.* (2013) in China reported that the facial laceration of dog bite wounds must be primary closed immediately after formal and thoroughly debridement, and the primary closure would shorten healing time of dog bite wounds without increasing rate and period of infection.

Surgical consultation: Surgical consultation was indicated for the following wounds (Faciszewski and Coleman, 1989): 1- Deep wounds penetrate bone, tendons, joints, or

other major structures, 2- Complex facial lacerations, 3- Wounds associated with neurovascular compromise, & 4- Complex infected wounds (abscess, osteomyelitis, or joint infection)

Antibiotic prophylaxis: Prophylactic antibiotics reduce the rate of infection due to some animal bites, especially cat bites. Although routine antibiotic prophylaxis is not recommended, prophylaxis is warranted in certain high-risk wounds (Callaham, 1980).

Deep puncture wounds (especially due to cat bites) may be: 1-Moderate to severe wounds with associated crush injury, 2-Wounds in area of underlying venous and/or lymphatic compromise, 3- Wounds on the hand(s), genitalia, face, or in close proximity to a bone or joint (particularly hand and prosthetic joints), 4- Wounds requiring closure, & 5- Bite wounds in compromised hosts (e.g., immunocompromised, absent spleen or splenic dysfunction, and adults with diabetes mellitus)

Human bites in children are typically trivial and do not require antibiotic prophylaxis. However, prophylaxis should be provided to human bites through the dermis, especially wounds to the hand, because of the higher risk of infection. If patients receive antimicrobial prophylaxis, the first dose should be given as soon as possible after the injury. Some physicians prefer to give the initial dose parenterally to rapidly obtain effective tissue levels in patients with cat or dog bites or human bites. Oral antibiotics may subsequently be given for three to five days following initial treatment of dog or cat bites or human bites.

Tetanus and rabies prophylaxis: Both must be indicated as animal and human bites are tetanus prone wounds. The patient's tetanus immunization status should be determined for any bite wound that breaks skin (Muguti and Dixon, 1992). Tetanus is a nervous system disorder characterized by muscle spasms that is caused by the toxin-producing anaerobe, *Clostridium tetani*, which is found in the soil. The clinical features of tetanus and its relationship to traumatic injuries were well known among the ancient Greeks and Egyptians and too many clinicians before the introduction of vaccination with tetanus toxoid in the 1940s. The term "lockjaw" (now called trismus) lives in modern parlance as a reminder of one of the cardinal features of tetanus: intense painful spasms of the masseter muscles. Tetanus toxoid, DTaP, or Td should be administered during the first encounter in patients. Rabies is a frequent concern with animal bites, especially when the attack is unprovoked or the animal appears ill, is wild, or is a stray. In the United States CDC (2019) provides guidance regarding the risk for rabies and the need for post-exposure prophylaxis based on type of animal exposure. The most common initial sign is spasms of the muscles of the jaw, or “lockjaw”. Tetanus symptoms include: 1-Jaw cramping, 2- Sudden, involuntary muscle tightening (muscle spasms) – often in the stomach, 3- Painful muscle stiffness all over the body, 4-Trouble swallowing, 5- Jerking or staring (seizures), 6- Headache, 7- Fever and sweating, & 8- Changes in blood pressure and fast heart rate. Complications that can happen because of tetanus include:1-Uncontrolled/involuntary tightening of the vocal cords (laryngospasm), 2- Broken bones (fractures), 3- Infections gotten by a patient during a hospital visit (hospital-acquired infections), 4-Blockage of the main artery of the lung or one of its branches by a blood clot that has travelled from elsewhere in the body through the bloodstream (pulmonary embolism), 5- Pneumonia, a lung infection, that develops by breathing in foreign materials (aspiration pneumonia), & 5-Breathing difficulty, possibly leading to death (1 to 2 in 10 cases are fatal)

Bites, scratches, abrasions, or contact with animal saliva via mucous membranes or a break in the skin all can transmit rabies. Rabies results in death of approximately 55,000 people annually, with most of the causes due to dog bites (WHO, 2013). Although rabies is common among wildlife species, human

rabies is rarely acquired. Highest incidence occurs in children younger than 15 years old. Incubation period usually ranges from 1 to 3 months, but may be short as 5 days or more than 6 months (Willoughby, 2016). Modern day prophylaxis is nearly 100% successful. Only 10% to 15% of persons bitten develop the disease, but when symptoms are present, rabies progresses to a fatal outcome. In the United States, human fatalities associated with rabies occur in people who fail to seek medical attention, usually because they are unaware of their exposure.

Viral prophylaxis after human bites: Any unvaccinated patient or individual negative for anti-HBs antibodies that was bitten by an individual positive for HBsAg should receive hepatitis B immune globulin (HBIG) & hepatitis B vaccine. If the source is unknown or not available for testing, the clinician should initiate the hepatitis B vaccine series. Individuals, who work in facilities where the risk for human bites is high, such as institutions for cognitively impaired, should be given the hepatitis B vaccine series upon employment. In addition, although the risk for transmitting HIV through saliva is extremely low, infection is of concern if there is blood in the saliva. Counseling regarding post-exposure HIV prophylaxis is appropriate in this setting (Havens, 2003).

Infected bites: To successfully manage an infected wound, the clinician must recognize early signs of infection and be aware of the likely pathogens. If a bite wound appears to be infected, the following actions should be taken: 1- Remove suture material, if previously repaired, & 2- Obtain Gram stain and aerobic and anaerobic cultures from the depth of an infected puncture or laceration prior to the initiation of antibiotics. The laboratory requisition should note that an animal or human bite wound is the culture source, 3- Draw aerobic and anaerobic blood cultures prior to antibiotic therapy in patients with signs of systemic infection, 4- Consult a surgeon for possible operative exploration, debridement, and drainage if abscess formation or suspected infection of bone, joint, or other major underlying structure (e.g., clenched fist infections and other hand infections) is present. Debrided material must be sent for aerobic and anaerobic culture, & 5- Hospitalized patients with systemic symptoms or progression or development of infection despite receiving oral antibiotics.

Empiric antibiotic therapy: Once a bite becomes infected, it is crucial to perform aggressive debridement and abscess drainage, as indicated, and to administer IV broad-spectrum antibiotics to cover probable infecting bacteria in patients with dog or cat bites or human bites. A common approach involves initial IV therapy until infection is resolving followed by oral therapy to complete a course of 10 to 14 days.

Superficial wound infections without abscess formation may be managed with wound debridement, oral antibiotic therapy, and close outpatient follow-up.

Deeper structure infection (e.g., osteomyelitis) requires a longer duration of therapy. Consultation with an infectious disease specialist is warranted for complicated infections. Unusual animal bites: The principles of wound management remain the same for bites by other animals. Bites of most small animals, as squirrels, rodents (e.g., rats), rabbits, and Guinea pigs, should generally be treated in the same way as cat bites (USDA, 2021). The potential for deep structure injury and life-threatening wounds increases with the size of the animal involved such as alligators, sharks, & large carnivores (Freer, 2007).

Antibiotic prophylaxis and empiric antibiotic therapy for infected wounds typically involves broad spectrum coverage of Gram positive, Gram negative and anaerobic bacteria, similar to victims of dog or cat bites. In some instances, pathogens in bite wounds are significantly different such as *Aeromonas* species in alligator bites, *Salmonella* species in iguana bites, *Vibrio* species in shark bites (Kelsey *et al,* 1997). When possib-

le, wound cultures should guide antimicrobial therapy for infected wild animal bites. Depending on the species, bacterial, fungal, or viral cultures may be necessary. Consultation with an infectious disease specialist is recommended for bites by exotic animals (Pavia *et al,* 1989).

Overtime, the spectrum of animals that are kept as pets has grown. So, types of zoonoses from pets as the dogs (Sabry *et al,* 2012), cats (Sabry *et al,* 2013), pet horses, donkeys and mules (Morsy *et al,* 2014 and household insects (Morsy, 2012) led to secondary infection increasing of superficial bites and scratches.

Follow-up Care: Patients who are discharged after initial care should follow-up with their primary care provider or other appropriate clinician within 24 to 48 hours to assess the wound status.

Complications: The most serious complications of animal bites include trauma to deep structures, and infections, either transmitted or arising in wound (Flandry *et al,* 1989). Also, children who have suffered dog bites requiring at least minor surgical intervention may develop symptoms of post-traumatic stress disorder (PTSD).

Systemic infections: Any infected bite wound can progress to infection of underlying structures (bone, joint, & tendon) and to bloodstream infection. Human bites can transmit numerous other infections, such as HBV & HCV, *Herpes simplex* virus & rare primary syphilis (Richman and Rickman, 1993).

Risk for transmitting HIV via saliva is extremely low but is concerned with blood in the saliva. Counseling regarding post-exposure HIV prophylaxis is appropriate in this setting (Snyder, 1989). Management of HIV patients who initiate antiretroviral therapy: After a diagnosis of acute or early HIV infection is made, patients should ideally be referred to a provider with experience in the HIV management. Physician also offers all patients with early HIV opportunity to participate in clinical studies exploring the pathogenesis of HIV disease and its immunologic response (Yanik *et al,* 2012). If the decision is made to treat a patient with acute or early HIV infection, the ultimate choice of antiretroviral regimen should be guided by results of drug resistance testing, as transmission of virus harboring at least one resistance mutation was reported in up to 20% of patients with the early HIV infection (Jain *et al,* 2010).

However, treatment must optimally not to be delayed while awaiting results of resistance testing in a setting of acute or early HIV infection. In such cases, a regimen that contains a boosted protease inhibitor may be preferable to a regimen with a non-nucleoside reverse transcriptase inhibitor, as resistance to latter was the commonest (Deeks, 2006). Also, a regimen containing a boosted protease inhibitor may retain efficacy despite the presence of certain common resistance mutations. In a study of 109 patients with primary HIV infection, the 13 patients infected with virus that harbored minority variant resistance mutations (including M184V mutation that confers resistance to lamivudine & emtricitabine) all achieved virological sup pression on a protease inhibitor-based drug (Metzner *et al,* 2010). Once results of resistance testing are available, treatment modifications can be made accordingly.

Any patient negative for anti-HBs antibodies and bitten by an individual positive for HBsAg must receive both hepatitis B immune globulin (HBIG) and hepatitis B vaccine. Personal working in facilities where human bites risk is high, such as institutions for cognitively impaired, should be given hepatitis B vaccine series upon employment.

Post-traumatic stress disorder: Children who have suffered dog bites requiring at least minor wound repair, particularly if the wounds are deep or multiple, may develop symptoms of post-traumatic stress disorder; PTSD (Peters *et al,* 2004). In one prospective study, the parents of 22 children who presented to an emergency department for minor surgical treatment of dog bites agreed to complete a questionnaire and undergo a

mobile and/or personal interview about the injury circumstances and the child's behavior before and after it occurred. Interviews took place between two and nine months after the incident. Among the 22 children, 12 had symptoms of PTSD for at least one month (five children met all of the DSM-IV criteria and seven met only some).

Conclusion and Recommendations

Most animal bites are caused by dogs, cats, and humans. Predominant organisms in animal bite wounds are oral flora of the biting animal and human skin flora (such as Staphylococci and Streptococci). Typical location and nature of the injury differs depending upon the animal inflicting the bite.

After appropriate of local anesthesia, wound must be carefully explored to identify injury to identify structures and presence of a foreign body. Appropriate imaging was to obtain deep bite wounds near bone and/or joints and when a foreign body is suspected as the plain radiograph or ultrasound.

Head computed tomography is warranted in patients with a deep dog bite to the scalp, including puncture wounds, especially in children less than two years of age. If a bite wound was infected, Gram stain and aerobic and anaerobic cultures should be obtained prior to initiation of antibiotics. Wound cultures are not indicated in clinically uninfected bite wounds as results do not correlate with the likelihood of infection or the pathogen that is present in patients with subsequent infection.

Wound management by irrigation and debridement of devitalized tissue are essential components in the bite wounds initial management. The wound must be carefully explored to identify injury to underlying structures and presence of a foreign body. Primary closure of open lacerations in healthy patients must meet all the following criteria (Grade 2B): 1- Cosmetically important (facial lacerations), 2- Wounds clinically uninfected, 3- Wounds less than 12 hours old (24hrs on face), 4- Wounds not located on hand or foot, & 5- Wound sealing with cyanoacrylate tissue adhesive (glue) must be avoided. But, not to close wounds at high risk for infection development including the following types of wounds (Grade 2C): 1- Crush injuries, 2- Puncture wounds, 3- Bites involving hands or feet, 4- Wounds more than 12hrs old (24hrs old on face), 5- Cat or human bites (except on the face), 6- Bite wounds in compromised hosts such as immunocompromised, absent spleen or splenic dysfunction, venous stasis, adults diabetes mellitus, 7- Tetanus and rabies prophylaxis must be given as indicated, 8- Surgical consultation may be indicated in selected circumstances, & 9- Discharged patients after initial care must be follow-up with their primary care provider or other appropriate clinician within 48 to 72hrs to assess the wound status.

Prophylaxis with oral antibiotics must be given for patient circumstances, and patients with deep or severe wound infections better treated with antibiotics IV rather than oral

Virus transmission after human bite: a- Any patient negative for anti-HBs antibodies when bitten by an individual positive for HBsAg should receive both hepatitis B immune globulin (HBIG) and hepatitis B vaccine, & b- Risk for transmitting HIV through saliva is extremely low but, if there is blood in saliva. Counseling regarding post-exposure HIV prophylaxis is a must in this setting.

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Table 1: Empiric intravenous antibiotic therapy for animal bites

Adults	Children
Options for empiric gram-negative and anaerobic coverage include:	
Ampicillin-sulbactam 3 g every 6hrs	50mg/kg/dose (based on ampicillin component) every 6hrs*
Piperacillin-tazobactam 4.5 g every 8hrs	125mg/kg/ dose (based on piperacillin component) every 8hrs*
Ticarcillin-clavulanate 3.1 g every 4hrs	50mg/kg/dose (based on ticarcillin component) every 4hrs*
A third generation cephalosporin such as ceftriaxone 1g IV every 24hrs & Metronidazole 500mg IV every 8hrs	A third generation cephalosporin as ceftriaxone 100mg/ kg/ dose every 24hrs*& Metronidazole 10mg/kg/dose every 8hrs*
Alternative empiric regimens include:	
Ciprofloxacin 400mg IV every 12hrs or levofloxacin 500mg IV daily) & metronidazole 500mg IV every 8hrs	Use fluoroquinolones with caution in children <18 years of age
Monotherapy with a carbapenem•, such as one of the following:	
Imipenem-cilastatin 500mg every 6hrs	25mg/kg/dose every 6hrs (maximum 500mg/dose)
Meropenem 1g every 8hrs	20mg/kg/dose every 8hrs (maximum 1g/dose
Ertapenem 1g daily	15mg/kg/dose every 12hrs for children up to 12years (maximum 500mg/dose)

* Maximum pediatric dose: See adult dose, • Carbapenems not used for patients with history of immediate-type hypersensitivity to beta-lactams.

Table 2: Empiric oral antibiotic therapy for animal bites

Antibiotic	Adults	Children
Amoxicillin clavulanate	875/125 mg twice daily	20 mg/kg/ dose (amoxicillin component) two times daily (maximum 875mg amoxicillin and 125mg clavulinic acid/ dose) •
Alternate empiric regimens include: One of the following agents with activity against *P. multocida*:		
Doxycycline*	100 mg twice daily	Not recommended in children <8 years of age
TMP-SMX*	1 double strength tablet twice daily	4-5mg/kg (trimethoprim component) /dose twice daily (maximum 160 mg trimethoprim/dose)
Penicillin VK	500 mg four times daily	12.5 mg/kg per dose four times daily (maximum 500mg/ dose)
Cefuroxime	500 mg twice daily	10 mg/kg per dose twice daily (maximum 500mg/dose)
Moxifloxacin	400 mg once daily	Use with caution in children <18 years of age
One of the following agents with anaerobic activity:		
Metronidazole	500 mg three times daily	10 mg/kg/ dose three times daily (maximum 500mg/ dose)
Clindamycin*	450 mg three times daily	10 mg/kg/dose three times daily (maximum 450mg/ dose)
The following agents have poor activity against *P. multocida* and should be avoided: Cephalexin, Dicloxacillin, or Erythromycin		

* Active against MRSA (check susceptibility testing). TMP-SMX: Trimethoprim-sulfamethoxazole, •Infected bites, clinician may increase dose to 45mg/kg (amoxicillin component) twice daily (maximum 875mg amoxicillin &125mg clavulinic acid).

Table 3: Empiric oral antibiotic therapy for human bites

Antibiotic choice:	Dosing for adults	Dosing for children
Amoxicillin-clavulanate	875/125mg twice daily	20 mg/kg/dose (amoxicillin component) twice daily (maximum 87mg amoxicillin &125mg clavulinic acid/dose)*
One of the following agents with activity against *Eikenella*: Alternate empiric regimens include:•		
Doxycycline Δ	100 mg twice daily	Not recommended in children <8 years of age
Trimethoprim-sulfamethoxazole Δ	1 double strength tablet 2/day	4-5 mg/kg/dose twice daily (maximum 160mg trimethoprim /dose)
Penicillin VK	500 mg four times daily	12.5 mg/kg/dose four times daily (maximum 500mg/dose)
Cefuroxime	500 mg twice daily	10 mg/kg/dose twice daily (maximum 500mg/dose)
Fluoroquinolones (one of the following):		
Ciprofloxacin	500 to 750 mg twice daily	Use with caution in children <18 years of age
Moxifloxacin	400 mg once daily	Use with caution in children <18 years of age
PLUS One of the following agents with anaerobic activity:		
Metronidazole	500 mg three times daily	10 mg/kg/ dose three times daily (maximum 500mg/dose)
Clindamycin Δ	450 mg three times daily	10 mg/kg/dose three times daily (maximum 450mg/dose)
The following agents have poor activity against *Eikenella* and should be avoided: Cephalexin Dicloxacillin orErythromycin		

*Infected bites, clinician may increase does to 45mg/kg (amoxicillin component) twice daily (maximum 875mg amoxicillin &125 mg clavulinic acid). • Preferred pencillin for allergic pediatric patients is trimethoprim-sulfamethoxazole OR cefuroxime & clindamycin (when liquid drug availability and palatability). Δ May be active against MRSA (check susceptibility testing).

Table 4: Recommended post-exposure prophylaxis for percutaneous or per-mucosal exposure to hepatitis B virus

Treatment if source	HBsAg positive	HBsAg negative	Not tested or unknown
Vaccination & antibody response status of exposed person			
Unvaccinated	HBIG x 1; initiate HB vaccine series	Initiate HB vaccine series	Initiate HB vaccine series
Previously vaccinated			
Known responder	No treatment		
Known non-responder	HBIG x 2 or HBIG x 1 & initiate revaccination	No treatment	Risky, treat as in HBsAg positive
Antibody response unknown	Test exposed person for anti-HBs	No treatment	Test exposed person for anti-HBs
	If adequate*, no treatment		If adequate*, no treatment
	If inadequate*, HBIG x 1 & vaccine booster		If inadequate*, initiate revaccinated

HBsAg: HB surface antigen; HBIG: HB immunoglobulin; HB vaccine series: HB vaccine; anti-HBs: antibody to HB surface antigen. For dosing "HB immune globulin: Drug information" & "HB vaccine: Drug information". * Responder= defined a person with adequate serum antibody levels to HB surface antigen (ie, ≥10 mIU/mL); inadequate response to vaccination defined as serum anti-HBs <10 mIU/ml.

Table 5: Rabies post-exposure prophylaxis

Vaccination	Biologic	Schedule
Not vaccinated	RIG	Total dose 20units/kg body wt. as full dose as feasible infiltrated around wound(s) & any remaining given IM.
	Vaccine	Human diploid cell vaccine) or purified chick embryo cell vaccine 1ml, IM (deltoid area), 1 each on days 0, 3, 7 &14*
Previously vaccinated	RIG	Not indicated
	Vaccine	HDCV or PCECV 1 mL, IM (deltoid area), 1 each on days 0 and 3

RIG: rabies immune globulin.*Immunosuppression persons, rabies postexposure prophylaxis given using 5 vaccine doses of on days 0, 3, 7, 14, & 28.

Table 6: Wound management and tetanus prophylaxis

Human	Clean and minor wound		All other wounds [Δ]	
Previous doses of tetanus toxoid*	Tetanus toxoid-containing vaccine [◊]	tetanus immune globulin	Tetanus toxoid-containing vaccine [◊]	tetanus immune globulin [§]
<3 doses or unknown	Yes [¥]	No	Yes [¥]	Yes
≥3 doses	If last dose given ≥10 years ago	No	Last dose given ≥5 years ago ◊	No

Appropriate tetanus prophylaxis administered as soon as possible after a wound, but even to patients presented late. Incubation period most cases within 8days, but may be one day or several months. *Tetanus toxoid administered as diphtheria-tetanus toxoids adsorbed (DT), diphtheria-tetanus-acellular pertussis (DTaP), tetanus-diphtheria toxoids adsorbed (Td), booster tetanus toxoid-reduced diphtheria toxoid-acellular pertussis (Tdap), or tetanus toxoid (TT).

Δ Such as, but not limited to, wounds contaminated with dirt, feces, soil, or saliva; puncture wounds; avulsions; wounds resulting from missiles, crushing, burns, or frostbite. ◊ Preferred vaccine preparation depends upon age and vaccination history of patient: <7 years: DTaP, Underimmunized children ≥7 & <11 years who not received Tdap previously: Tdap. Children receiveg Tdap between age 7 and 11 years do not revaccination at age 11 years, ≥11 years: A single dose of Tdap preferred to Td for all individuals not previously received Tdap, Td preferred to TT for those who previously received Tdap and when Tdap not available. § 250 units IM at a different site than tetanus toxoid; IV immune globulin must be given if human tetan-us immune globulin not available. ¥ Vaccine series must be continued through completion as necessary. ‡ Booster doses given more frequently than every five years are not needed and can increase adverse effects.

Table 7- Diagnostic criteria for post-traumatic stress disorder

Criterion A: Person exposed to a traumatic event in which both of the following were present:	Person experienced, witnessed or confronted with an event or events that involved actual or threatened death or serious injury, or a threat to physical integrity of self or others.
	Person's response involved intense fear, helplessness or horror. Note: children may be expressed instead by disorganized or agitated behavior.
Criterion B: Traumatic event persistently re-experienced in one (or more) of the following:	Recurrent and intrusive distressing recollections of event, including images, thoughts, or perceptions. Note: young children, repetitive play may occur in which themes or aspects of trauma are expressed.
	Recurrent distressing dreams of event. Note: children may be frightening dreams didn't recognize content
	Acting or feeling as if traumatic event were recurring (including a sense of reliving experience, illusions, hallucinations and dissociative flashback episodes, including those that occur on wakening or when intoxicated). Note: young children trauma-specific reenactment may occur
	Intense psychological distress and/or physiological reactivity on exposure to internal or external cues that symbolize or resemble an aspect of traumatic event.
Criterion C: Persistent avoidance of stimuli associated with trauma and numbing of general responsiveness (not present before trauma), as indicated by 3 (or more) of following:	Efforts to avoid thoughts, feelings or conversations associated with the trauma
	Efforts to avoid activities, places or people that arouse recollections of the trauma
	Inability to recall an important aspect of trauma
	Markedly diminished interest in participating in significant activities
	Feeling detached or estranged from others
	Restricted range of effect (unable to have loving feelings)
	Sense of a foreshortened future (not expect to have a career, marriage, children, or a normal life span)
Criterion D: Persistent symptoms of increased arousal (not before trauma), as indicated by 2 (or more) of following:	Difficulty falling or staying asleep
	Irritability or outbursts of anger
	Difficulty concentrating
	Hyper-vigilance
	Exaggerated startle response
Criterion E: Duration of disturbance (symptoms in criteria B, C, & D) more than one month.	
Criterion F: Significant distress or impairment in social, occupational, or other functioning areas. Specify if:	Acute: if duration of symptoms less than three months
	Chronic: if duration of symptoms three months or more
	With delayed onset: if onset of symptoms at least six months after stressor

Adapted from: **Diagnostic and Statistical Manual of Mental Disorders, 1994:** 4th Edition, American Psychiatric Association, Washington, DC.

Explanation of figures

Fig. 1: Aggressive dog bite,
Fig. 2: a- Aggressive cat biting her owner woman, b- Secondary infected cat bite.
Fig. 3: Secondary infected human bite.
Fig. 4: Stray (Street) dogs.
Fig. 5: Skin layer showed moderate inflammatory cell infiltrated with lymphocytes & plasma cells, stroma with many blood capillaries permeation.
Fig. 6: Rabies virus in a section stained with immunoperoxidase stain