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GENERAL INFORMATION

Mammal bite management[☆]



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Abstract

Background: Animal bites are a major public health problem, it is estimated that 2% of the population is bitten each year. Most bites are by dogs and the risk factors include young children, men, certain breeds of dogs and untrained dogs. The risk of infection after bites differs between animal species and depends on the animal teeth and oral flora.

Conclusions: Animal bites are still a major cause of morbidity in patients of all ages and have caused several preventable childhood deaths. These wounds often become infected. If the wound requires it, early surgical evaluation must be performed. The use of antibiotics is only recommended for high-risk bite wounds.

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PALABRAS CLAVE

Mordeduras de
mamífero;
Herida;
Infección;
Profilaxis antibiótica;
Tratamiento
quirúrgico

Manejo de las mordeduras por mamíferos

Resumen

Antecedentes: Las mordeduras de animales son un problema importante de salud pública: se estima que el 2% de la población es mordida cada año. La mayoría de las mordeduras son de perro y los factores de riesgo incluyen niños pequeños, hombres, ciertas razas de perros y perros no adiestrados. El riesgo de infección posterior a las mordeduras difiere entre las especies animales y depende de la dentición de los animales y de la flora oral.

Conclusiones: Las mordeduras de animales siguen siendo una causa importante de morbilidad en pacientes de todas las edades y han causado varias muertes infantiles prevenibles. Estas

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heridas comúnmente se infectan. Si la herida lo requiere, se debe realizar valoración quirúrgica temprana. El uso de antibióticos solo se recomienda para las heridas por mordedura de alto riesgo.

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Background

Animal bites are a major public health problem: it is estimated that 2% of the population is bitten every year. The majority of bites are by dogs, and the risk factors include small children, men, certain breeds of dog and untrained dogs. The risk of infection following a bite differs between animal species and depends on their teeth and oral flora.

It has been estimated that dog bites represent 60–90% of all bites, while those by cats amount to 5–20% and those by human beings 4–23% of the total. Mammal bites account for almost 1% of visits to A&E facilities in the United States.¹ The annual medical cost of treating these lesions is more than 100 million dollars.²

Studies have found that human bites are more common among men and peak in incidence between the ages of 18 and 78 years old (median: 28 years old). A study of 388 patients with bites by humans found that more than half of them (50.3%) had been bitten on the hands or fingers, 23.5% in an extremity and 17.8% in the head or neck.³ The majority of patients (76.2%) visited an A&E department within 12 h. of the injury occurring. Although the majority of patients (77.3%) were given antibiotics, 11.1% were admitted to hospital. Patients with bite injuries are often under the toxic effects of alcohol, so that the process of obtaining a trustworthy description of the incident and performing a detailed examination is often difficult. These patients are often reluctant to admit the cause of their injury and offer untrue descriptions. The rate of infection after a human bite stands at approximately 10%.⁴

Microbiology of the flora isolated in the bites of different mammals

Dogs: *Pasteurella dagmatis*, *P. canis*, *Staphylococcus aureus*, *S. intermedius*, *Streptococci*, *Moroxella* spp., *Neisseria* spp., *Capnocytophaga canimorsus*, *Clostridium* spp., including *Clostridium tetani*, *Anaerobios* spp.⁵

Cats: *Pasteurella multocida*, mixed aerobic and anaerobic organisms.⁶

Rodents: *Streptobacillus moniliformis*, *Spirillum minus*, *Salmonella* spp.⁷

Cows, horses and camels: polymicrobial, *Actinobacillus* spp.⁸

Pigs: polymicrobial, *Actinobacillus* spp.⁹

Humans: *Viridans streptococci*, *S. pyogenes*, *S. aureus*, *Anaerobes*, *Eikenella corrodens*, hepatitis B and C, human immunodeficiency virus.¹⁰

Monkeys: Mixed aerobic and anaerobic, *Streptococci*, *Neisseria* spp., *Haemophilus influenzae*, *Herpes simiae* (B virus).¹¹

Clinical symptoms

Dog bite

Children under the age of 5 are at the highest risk of suffering a dog bite, which is often on the face, while adults tend to be bitten on the upper limbs. The majority of dog bites in men occur when the animal is free (wandering). 66% of bite victims are the dog's owner or know the dog, and approximately half of the dogs are provoked.¹² A study of attacks by dogs in Adelaide found that 3/4 of them were caused by 5 of the 160 breeds there, in spite of the fact they only represent 31% of the dog population. German shepherd dogs, Pit bull terriers, blue/red Australian Cattle Dogs, Dobermans and Rottweillers were 4 or 5 times more likely to bite than other breeds. It is important not to solely blame these breeds: training as well as castration may also play a role here.¹³ Up to 18% of dog bites become infected.^{14,15}

The results revealed a far broader range of organisms than had been thought, and more organisms were isolated in a reference laboratory than in the usual hospital laboratory. An average of 5 organisms were isolated, most usually a mix of aerobic and anaerobic ones. Species of *Pasteurella* were isolated in 50% of dog bites: this is an important finding, given that this organism had been thought to be rare in cases of dog bite.⁵

Cat bite

Cats have long thin incisors which almost always cause puncture wounds. Although these may seem minor on the surface of the skin, they may penetrate deeply and puncture the bone marrow, joints or tendons. These wounds are difficult to debride and disinfect, and this is particularly important in the hand, where doctors may easily overlook joint penetration. From 28% to 80% of cat bites become infected.⁶

Talan et al.⁵ observed the microbiology of 57 cat bites and found *Pasteurella multocida* in 75% of them. *Pasteurella multocida* is characteristically located on the skin, and infection of the soft tissues develops swiftly, with or without systemic effects. *Pasteurella* is the predominant organism in the oral flora of many species, and interestingly some animals use *Pasteurella* to hunt in nature: they injure their

prey in ways that are not life-threatening, and the latter subsequently die due to sepsis caused by *Pasteurella*.

Rodents

Fever due to rat bite is a disease caused by *Streptobacillus moniliformis* or *Spirillum minus*. It is characterised by three symptoms of fever, a rash and arthritis. It is most often transmitted by the bite of a rat with 50–100% of nasopharyngeal colonisation, although it may also occur due to the bites of other species of mammals.¹⁶ Rodent bites have an infection rate of approximately 10%.¹⁷ Rats are becoming increasingly popular as pets, and although the prevalence of this disease is unknown, there is no evidence that it is an emerging pathogen.¹⁸ It is notably hard to diagnose rat bite fever: its clinical characteristics are confusing and may imitate rheumatoid arthritis.^{19,20} The organism is delicate and if it is not detected in the laboratory due to the characteristic appearance of Gram staining, it is hard to isolate in a culture. Diagnosis may be aided by good communication with laboratory staff. The natural history of this disease involves a succession of relapses and remissions, and in the majority of cases it resolves in a period of 2 weeks. Nevertheless, severe complications are sometimes reported, and if these are not treated then mortality may be significant.²¹ It is treated using penicillin or doxycycline and the majority of cases respond well.

Human bites

Human bites often go unnoticed when diagnosis takes place in the A&E department. Human bites lead to a higher rate of complication and infection than animal bites. The majority occur in the fingers, although 10–20% of wounds are ‘‘love bites’’ in the thorax and genitals.²² If a bite mark has an intercanine distance greater than 3 cm then it was probably caused by an adult, so that the possibility of child abuse should be considered if the bite is seen in a child.²³ It is possible to transmit hepatitis B and C by human bite.²⁴

It is rare for human immunodeficiency virus (HIV) to be transmitted, although this has occurred at least 5 times, above all in cases when the saliva contained blood residues and the disease was at an advanced stage. Although the evidence is limited, HIV post-exposure prophylaxis should be considered in cases of high-risk lesions due to human bite.²⁵

Diagnosis

Detailed examination should be performed under suitable lighting. The wound may be irrigated to facilitate examination. The extension of soft tissue damage, the depth of the bite, the involvement of tendons and the presence of infection or foreign bodies such as teeth must be evaluated. Special care must be taken in the case of bites during fights, and the examination must be performed by passively flexing the fingers so that the hand forms a closed fist, to aid the evaluation of damage to the extensor tendons. Due to its innocuous presentation, it is safer to consider all wounds on the back of the metacarpal joint to be injuries to the joint until the contrary is proven.⁴

The description of how the lesion occurred, its mechanism and any history of allergy in the patient must be obtained, together with the time elapsed since their last tetanus vaccination and whether the individual who bit them has any medical disease. All bite marks on young children should give rise to the suspicion of child abuse. Suspicious wounds must be photographed in the company of an authority, the skin should be completely examined and the relevant questions should be asked.²⁶

Complementary studies

Laboratory studies

No laboratory study is necessary in the initial emergency evaluation of mammal bite in those patients who will be treated on an out-patient basis. Patients with criteria that indicate surgery or hospitalisation must be studied for complete blood biometry, blood chemistry, serum electrolytes and coagulation times. This will take the form of an initial evaluation and will also be for inclusion in protocols if they require surgery, together with a C-reactive protein test for subsequent evaluation of their evolution.

Wound culture

Cultures (including anaerobic organism cultures) must be obtained from the depth of the wound if it is clinically infected. Early wound cultures are rarely useful. Blood cultures may be obtained if there is systemic toxicity or if the patient is immunocompromised.²⁷

Simple X-rays and ultrasound scans

X-rays must be obtained for all closed lesions and in wounds that penetrate the scalp of children, to rule out fracture, the presence of foreign bodies or tooth fragments in the wound, or, in late cases, osteomyelitis. As Staiano and Graham have shown, the presence of tooth fragments in the wound may be hazardous, so that all efforts must be made to rule out the presence of foreign bodies in bite wounds.²⁸

Initial treatment

Little scientific evidence exists regarding the treatment of animal bite wounds. There are few prospective randomised clinical studies, and the majority of recommendations for treatment are based on expert opinion. The majority of patients attempt some form of self-treatment before requesting medical assistance.²⁹

The first step in treatment is to clean and irrigate the wound with saline solution, 1% iodopovidone or room temperature running water using a 20 ml or larger syringe and a 19 gauge needle. This will supply a high-pressure jet of water that will reduce the bacterial inoculate and debride the wound. However, irrigation must be in the direction of the penetrating wound and care must be taken to prevent injecting tissue or causing additional damage.³⁰

This must be followed by debridement of devitalised tissue if necessary. Necrotic or devitalised tissue must be

debrided with care and in the awareness that residual defects or wound closure problems may be caused. As a rule puncture wounds should not be debrided.³¹

Even the simplest wounds require abundant irrigation and washing. If the bite wound is in a limb, this should be raised. If the bite affects a joint, this must be washed and immobilised.³² It is recommended that tetanus vaccine and tetanus immunoglobulin be administered to patients with a history of 2 vaccinations or fewer.²⁷

Surgery

The surgical treatment of bites in human varies from simple surgical examination of the wound to the repair of complex structures using a microscope. Children and mentally handicapped individuals may require anaesthesia to facilitate a thorough examination. The indications for surgery are the presence of severe infection in soft tissues, abscesses, the penetration of joints, underlying fracture, tendon breakage, osteomyelitis, tenosinovitis, septic arthritis, neurovascular involvement or the presence of a foreign body such as tooth fragments in the wound. The decision to surgically close a human bite wound depends on many factors. In general human bite wounds are contaminated, and this is why closure by primary surgery may be delayed.³³ A prospective cohort study by Chen et al.³⁴ showed that the primary closure of bite wounds is associated with higher rates of infection (6%) in comparison with other wounds sutured in the same institution (3.4%).

Although the primary repair of bite wounds is associated with higher rates of infection, it is still indicated for bite wounds when the cosmetic result is important. As bite wounds on the face are associated with more bleeding, they run less risk of infection after primary closure. The primary closure of all non-infected facial wounds is therefore indicated, while debridement and delayed closure may be used for certain high risk wounds or ones that are already infected.³⁵

Bite wounds must be closed using a standard percutaneous technique with a non-absorbable suture such as single thread nylon or polypropylene. Closures with multiple layers or subcutaneous sutures must be avoided unless they are absolutely necessary. Surgical closure is not indicated for non-facial wounds, especially deep penetrating ones, wounds caused more than 24 h previously, bites on the hands and clinically infected wounds, due to increasing rates of infection. Adhesive strips and delayed surgical closure may be used in these cases.³¹

In all cases when a wound is closed, the patient must be called for follow-up after 48 h and 72 h. As lesions in the hands are associated with a higher rate of infection, an expert hand surgeon should be consulted. A surgeon must be consulted in all cases of bites caused by fighting or those involving lesions to the tendons or deep structures, or when complications such as infections arise. If wounds in the hands become infected, physiotherapy normally starts 3–5 days after the infection has been resolved, to recover the functioning of the affected hand.³²

Treatment in hospital is recommended for patients with associated fractures, septic arthritis or involvement of the joint capsule or tendons, etc. Suitable instructions at

discharge and ensuring proper follow-up are highly important, as is the initial treatment. The patient must be educated on wound care and the signs of infection, in the case of which he should request immediate treatment.

Antibiotic prophylaxis

There are no clinical guides on the commencement of antibiotic prophylaxis after human bites. To date only 2 randomised clinical studies have examined the advantages of prophylactic antibiotics in human bite lesions. In the previous clinical study.³⁶

Antibiotics should cover the most common pathogens, such as *Streptococcus* (especially *Streptococcus anginosus*), *Staphylococcus* and *Eikenella*, with broad anaerobic coverage. According to Talan et al., in 50% of cases *Provetella* was isolated, while 80% of the strains of staphylococcus isolated in human bite wounds produced β -lactamase. The strains of *Eikenella* isolated were relatively resistant against clindamycin, erythromycin, aminoglycosides, anti-staphylococcus penicillin and first generation cephalosporins.³⁷

When cellulitis is already present a therapeutic interval of 10–14 days may be necessary. This may be prolonged for up to 3 weeks for tenosinovitis, 4 weeks for septic arthritis and 6 weeks for osteomyelitis. In practice intravenous (IV) therapy continues until C-reactive protein falls to less than 50 mg/l. After this time oral antibiotics may be administered. If the C-reactive protein does not fall or remains the same, clinical re-evaluation is advisable, together with a second debridement, especially for infections in joint spaces.²⁷

Anti-rabies and tetanus prophylaxis

Complete treatment for bite lesions must include vaccination against tetanus. Although any wound may be contaminated by tetanus spores, those contaminated with soil, saliva or certain types of wound such as those caused by crushing or puncture are more likely to be associated with tetanus inoculation. Patients with bite wounds who have not been vaccinated in the previous 5 years should be vaccinated. The administration of human anti-tetanus immunoglobulin must be considered for those who are believed to have immunity alterations and those with wounds considered prone to tetanus.

Antiviral prophylaxis following human bites

Hepatitis B prophylaxis should be considered if patients are not immunised, together with HIV post-exposure prophylaxis if the risk is high (seek the advice of an expert in infectious diseases).

Antibiotic treatment

Infected bites

Metronidazol (children: 10 mg/kg up to 400 mg) oral, every 12 h during 14 days. Plus any of the following: cefotaxime

(children: 50 mg/kg up to 1 g) IV daily for 14 days or ceftriaxone (children: 50 mg/kg up to 1 g) IV daily for 14 days.

Alternatives

Piperacillin + tazobactam (children: 100 + 12.5 mg/kg up to 4 + 0.5 g) IV, every 8 h for 14 days, or ticarcillin + clavulanate (children: 50 + 1.7 mg/kg up to 3 + 0.1 g) IV, every 6 h for 14 days.

Prophylactic treatment

Amoxicillin + clavulanate (children: 22.5 + 3.2 mg/kg up to 875 + 125 mg) oral, every 12 h for 5 days. If this is used at first it is probable that procaine penicillin will be delayed (children: 50 mg/kg up to 1.5 g) intramuscular, in a single dose, followed by the previous regime.

In patients who are allergic to medication with a β -lactamic ring: metronidazol (children 10 mg/kg up to 400 mg) every 12 h for 14 days. Plus either of the following 2: doxycycline (children over the age of 8 years old, doxycycline 5 mg/kg up to 200 mg), an oral first dose after which the regime changes to 2.5 mg/kg up to 100 mg twice a day for 14 days. Plus trimetoprim/sulfamethoxazole (children 4/20 mg/kg) up to 160/800 mg orally every 12 h for 14 days or ciprofloxacin: (children 10 mg/kg up to 500 mg) orally every 12 h for 14 days.

Conclusions

Animal bites are still a major cause of morbidity in patients of all ages, and they have caused several preventable childhood deaths. These wounds often become infected, usually by a polymicrobial infection. Treatment includes the in-depth evaluation of the wound, a culture and cleaning; if indicated tetanus and rabies prophylaxis should be administered. Wounds at high risk of infection must be identified and antibiotic treatment must be given. It is important to underline the fact that third generation cephalosporin may be an effective therapy for bite wounds. Each bite lesion must be evaluated individually. Treatment must take into account the type of animal that caused the injury, patient risk factors for local infection and systemic infection indicators, together with the vaccination status of the patient. Early surgical consultation is recommended for wound debridement, especially if there is a possibility that the bite affected deep tissue or bone.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Conflict of interests

The authors have no conflict of interests to declare.

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