PEDIATRICS

Dog bites in Canadian children: a five-year review of severity and emergency department management

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ABSTRACT

Objectives: Dog bites are a common problem. The purpose of this study was to determine the characteristics of dog bites and their emergency department management in a Canadian pediatric population, and to provide treatment and prevention recommendations.

Methods: The charts of all children ≤16 years of age presenting with a dog bite to either of the 2 tertiary emergency departments in Edmonton, Alberta, between 1998 and 2002 were retrospectively reviewed.

Results: Overall, 287 cases were reviewed; 145 boys (50.5%) and 142 girls (49.5%). The mean age was 7.4 years. The patient's face was the most frequently bitten site (58.5%, *n* = 168), followed by an extremity (35.5%, *n* = 102). Most bites required sutures (54.5%, *n* = 155), and 72 (25.1%) were classified as severe, based on suture number (>10 sutures, *n* = 69), associated fractures (*n* = 4), operating room repair (*n* = 21) or fatality (*n* = 1). The mean age of children with severe bites was significantly lower than children with mild bites (6.3 v. 7.8 yr, $p < 0.01$). Most patients were treated solely in the emergency department (84.7%, *n* = 243); however 44 (15.3%) were admitted to hospital and required a total of 144 days of inpatient care. Signs of infection were described in 16 cases (5.6%); of these 8 had received 2 or more prior doses of antibiotics. Public health or police notification was documented in 56 cases (19.5%), and safety or preventive discussion was documented in 3 cases (1.0%).

Conclusions: Dog bites in Canadian children are common, often serious or even lethal, and not always managed ideally. Preventive discussion and public health contact is infrequently documented and likely seldom occurs. In addition to medical care, emergency department staff should provide and document preventive guidance and ensure involvement of public health or police when indicated.

Key words: dog bite; wound infection; injury; pediatric; rabies; prevention

RÉSUMÉ

Objectifs : Les morsures de chien sont un problème courant. Cette étude visait à déterminer les caractéristiques des morsures de chien et leur prise en charge à l'urgence dans une population pédiatrique canadienne, ainsi qu'à recommander des traitements et des mesures de prévention.

Méthodes : On a étudié rétrospectivement le dossier de tous les enfants de 16 ans ou moins qui se sont présentés avec une morsure de chien à l'un ou l'autre des deux services d'urgence de soins tertiaires d'Edmonton (Alberta) entre 1998 et 2002.

Résultats : On a étudié dans l'ensemble 287 cas : 145 jeunes garçons (50,5 %) et 142 jeunes filles (49,5 %). Les patients avaient en moyenne 7,4 ans et ont été mordus le plus souvent au visage (58,5 %, *n* = 168), et ensuite à un membre (35,5 %, *n* = 102). La plupart des morsures ont obligé à poser des points de suture (54,5 %, *n* = 155) et 72 (25,1 %) ont été classées comme sévères en

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fonction du nombre de points de suture (>10 points, *n* = 69), de fractures connexes (*n* = 4), de réparations en salle d'opération (*n* = 21) ou d'issue fatale (*n* = 1). Les enfants victimes d'une morsure grave étaient beaucoup plus jeunes que ceux qui avaient subi une morsure bénigne (6,3 c. 7,8 ans, *p* < 0,01). La plupart des patients ont été traités à l'urgence seulement (84,7 %, *n* = 243), mais 44 (15,3 %) ont été hospitalisés et ont nécessité au total 144 jours de soins en service interne. On a décrit des signes d'infection dans 16 cas (5,6 %), dont huit avaient reçu auparavant deux doses ou plus d'antibiotiques. On a documenté un avis au service de santé publique ou de police dans 56 cas (19,5 %) et une discussion sur la sécurité ou la prévention dans trois cas (1,0 %).

Conclusions : Les morsures de chien chez les enfants canadiens sont courantes, souvent sérieuses ou même mortelles, et ne sont pas toujours prises en charge idéalement. On documente peu souvent une discussion sur la prévention et un contact avec les services de santé publique, qui sont probablement rares. Outre les soins médicaux, le personnel du service d'urgence devrait donner des conseils sur la prévention, les documenter et assurer l'intervention des services de santé publique ou de police, le cas échéant.

Introduction

Dog bites are common and account for more injury-related emergency department (ED) visits than do injuries associated with playgrounds, all-terrain vehicles, rollerblading or skateboards.[1] Many dog bites are severe and some are fatal,[2,3] as underscored by the attention of the Canadian media on a recent series of serious bites.

There are an estimated 65 million pet dogs in the United States, and it is noteworthy that most dog bites are from an animal known to the victim.[4] The incidence, severity and risk factors associated with dog bites have been described in a number of US studies,[1–3,5–7] however we could identify only 1 previous study on Canadian children.[8] The purpose of our study was to determine the characteristics of dog bites and their ED management in a Canadian pediatric population, and to provide treatment and prevention recommendations.

Methods

The charts of all children ≤ 16 years of age presenting with a dog bite to either of the 2 tertiary EDs in Edmonton, Alta. (catchment population approximately 1 000 000) between 1998 and 2002 were retrospectively reviewed. Patients were identified through a computerized patient encounter database, using the search term "dog bite." The study was approved by the Research Ethics Board of the University of Alberta, Edmonton, Alta.

Charts were reviewed for patient, animal and bite characteristics and for documentation of prevention strategies. A bite was classified as "provoked" if the child had been playing with, teasing or feeding the dog at the time of the injury. The severity was classified as "mild" if the patient did not receive any sutures, "moderate" if 1–10 sutures were needed, or "severe" if >10 sutures were needed, there was an associated fracture, the wound was repaired under procedural sedation or in the operating room, the child was admitted to hospital, or the injuries were fatal. Bites were classified as infected if there was documentation of purulent discharge from the wound, or if 2 or more of the following were documented: erythema, warmth, pain or swelling. Police dog bites were excluded from the analysis.

Data are reported as raw numbers with percentages, or means ± standard deviation (SD) as appropriate. Between-group comparisons were performed using a 2-tailed Student's *t* test, and a *p* value of <0.05 was considered statistically significant. No adjustments were made for multiple statistical comparisons.

Results

In total, 302 dog bite cases were identified. Of these, 15 that involved police dogs were excluded, resulting in a study population of 287 cases. The frequency of dog bites was highest in the month of June (Fig. 1), and the annual number of cases trended downward during the 5-year study period (Fig. 2). The median time of day when bites occurred in the 177 cases with documented time was 1730 hours.

Patient characteristics

Table 1 summarizes the patient characteristics, including immunization status and disposition. The mean victim age was 7.4 ± 4.2 years (range: 4 mo to 16.9 yr). The mean age of children with severe bites was significantly lower than children with mild bites (6.3 ± 4.0 yr v. 7.8 ± 4.5 yr, $p < 0.01$), and there was no gender difference between these groups. There was no difference in the overall bite frequency or victim age between boys and girls ($n = 145$, age 7.7 ± 4.2 yr v. $n = 142$, age 7.2 ± 4.2 yr, respectively). Four patients had a history of prior dog bites. In 2 cases, the victim was bitten on 2 separate occasions by the same dog. Most cases were treated solely in the ED (84.7%, $n = 243$); however 44 patients

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(15.3%) were admitted to hospital and required a total of 144 days of inpatient care. Public health or police notification was documented in 56 cases (19.5%), and safety or preventive discussion was documented in 3 cases (1.0%). Routine immunizations were incomplete in 30 children (10.4%); 18 of these received tetanus and diphtheria immunizations, and 4 also received tetanus immune globulin. Sixty children (20.9%) had no documentation of their immunization status.

Animal characteristics

Table 2 summarizes the animal characteristics. In 212 cases (73.9%) the dog was known to the child, either as a family pet (110 cases, 51.9%), or through a friend or relative (102 cases, 48.1%). Documentation of the dogs' behaviour was infrequent. In 24 cases (8.4%), the bite was provoked (as defined by this study). The most common breeds* in the 72 cases in which the breed was specified were Rottweiler (21 cases, 28.8%) and German shepherd (11 cases, 15.1%).

*Chart information on the type of dog was probably provided by the victim's family in most cases; therefore, incorrect identification is possible, especially with the less recognizable breeds and with dogs unknown to the victim.

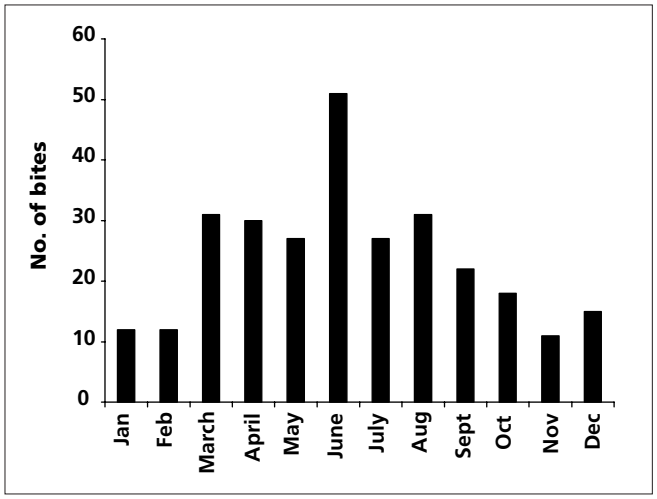

Fig. 1. Number of dog bites, per month (1998–2002).

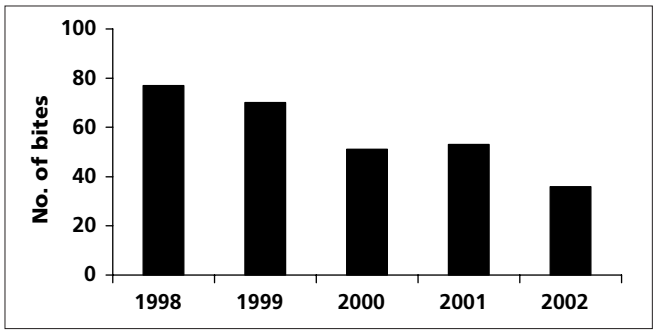

Fig. 2. Number of dog bites during the 5-year study period.

Bite characteristics

Table 3 summarizes the bite characteristics. The face was the most frequently bitten site (58.5%, n = 168), followed by an extremity (35.5%, n = 102). Most bites required sutures (54.5%, n = 155), and 72 cases (25.1%) were classified as severe. Twenty-one children (7.3%) required operating room repair of their bites (14 girls, 7 boys), and plastic surgery was the most frequently consulted service.

There was no difference in the number of severe bites in boys (33) and girls (38). Four patients had fractures associated with their bites (skull, mandible, arm and hand). In all 4 cases the victim knew the dog, and in 3 cases the breed was specified (Doberman pinscher, Rottweiler and wolf-dog). There was 1 fatality: a 2-year-old boy bitten in the neck by a husky known to the victim.

Rabies prophylaxis was administered to 5 patients (1.7%). Three of these had a severe bite to the face, 1 had a skull fracture, and the other had a severe bite to the neck and subsequently died in hospital. In all 5 cases, the attacking dog

Table 1. Chart information on the 287 patients whose cases were reviewed

Variable	No. (and %)*
Gender	
Boys; mean age, yr	145 (50.5); 7.7 ± 0.4
Girls; mean age, yr	142 (49.5); 7.2 ± 0.4
Immunization record	
Complete	197 (68.6)
Incomplete	30 (10.4)
Not documented	60 (20.9)
Disposition of patient	
ED care only	243 (84.7)
ED care and admission	44 (15.3)
No. of days in hospital	
1	14
2	7
3	10
4	3
5	3
6	3
7	1
8	1
11	1
15	1
Safety and/or preventive discussion documented	
Yes	3 (1.0)
No	284 (99.0
Public health and/or police notification documented	
Yes	56 (19.5)
No	231 (80.5)

*Unless otherwise specified.

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was known to the victim and did not have a history of unusual behaviour. The immunization status of the dog was not documented in 3 of these cases, complete in 1 case, and incomplete 1 case. Public health was involved in all 5 cases, and subsequent animal testing found no evidence of rabies.

Table 4 summarizes the signs of infection and antibiotic administration. Prophylactic antibiotics were prescribed to 213 patients (74.2%), 8 of whom still developed a wound infection. The most frequently prescribed antibiotic in these 8 cases was amoxicillin clavulanate (5 cases). Signs of infection were documented in 16 cases (5.6%). Of the 16 infected bites, 9 involved the hand, 6 the face and 1 the arm. Three of the 16 children had puncture wounds, all to the hand, and none had received prophylactic antibiotics. In the antibiotic group, wound irrigation was documented in only 1 case. Two children in this group also had their wounds sutured. In 1 case, an 11-year-old girl was bitten in the arm by a husky, needed more than 10 sutures, and was sent home on oral erythromycin. Two days later she developed cellulitis and required operating room débridement. In another case, a 7-year-old boy developed periorbital cellulitis 24 hours after a facial laceration was sutured (>10 sutures) and treated with amoxicillin clavulanate. Among the children who had not received any antibiotics, 5 patients had not re-

Table 2. Chart information on the dogs involved in the 287 cases reviewed

Variable	No. (and %)
Relationship to victim	
Known	212 (73.9)
Stray / stranger	29 (10.1)
Not documented	46 (16.0)
Vaccination record of the dog	
Complete	106 (36.9)
Incomplete	15 (5.2)
Not documented	166 (57.8)
Behaviour of dog	
Normal	31 (10.8)
Abnormal	12 (4.2)
Not documented	244 (85.0)
Type of dog*	
Not documented	215 (74.9)
Specified	72 (25.1)
Rottweiler	21 (28.8)
German shepherd	11 (15.1)
Husky	5 (6.8)
Pit bull†	4 (5.5)
Collie	4 (5.5)
Cocker spaniel	3 (4.1)
Doberman pinscher	3 (4.1)
Bulldog	2 (2.7)
Golden retriever	2 (2.7)
Sheepdog	2 (2.7)
Other‡	15 (20.5)

*Chart information on the type of dog was probably provided by the victim's family in most cases; therefore, incorrect identification is possible, especially with the less recognizable breeds and with dogs unknown to the victim
†See Discussion section for a definition of "pit bulls."
‡One case each involving the following breeds: Akita, beagle, basset hound, chow chow, dachshund, doxine, Great Dane, Labrador retriever, malamute, poodle, sheltie, springer spaniel, Saint Bernard, terrier and wolf-dog.

Table 3. Bite characteristics as recorded in the charts of the 287 cases reviewed

Variable	No. (and %)
Location of bite	
Face	168 (58.5)
Extremity	102 (35.5)
Head	4 (1.4)
Buttock	4 (1.4)
Chest	2 (0.7)
Neck	2 (0.7)
Scrotum	1 (0.3)
Severity of wound	
Mild	132 (46.0)
Moderate	83 (28.9)
Severe	72 (25.1)
>10 sutures	69 (95.8)
Fracture	4 (5.6)
OR repair	21 (29.2)
Fatality	1 (1.4)
Sutures required	
No	132 (46.0)
Yes	155 (54.0)
No. of sutures	
1–5	55 (35.5)
6–10	31 (20.0)
>10	69 (44.5)
Consultation required	
No	199 (69.3)
Yes	88 (30.7)
Plastic surgery	67 (76.1)
Ophthalmology	14 (15.9)
Infectious diseases	13 (14.8)
Orthopedics	3 (3.4)
Urology	1 (1.1)
Neurosurgery	1 (1.1)

OR = operating room.

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ceived any prior treatment and 3 others had no documentation of prior treatment, but were not on any medications. Three of these children had puncture wounds to the hand and developed cellulitis within 24 hours of the bite. One wound was swabbed and cultured *Pasteurella multocida*, *Staphlococcus aureus* and *Streptococcus viridans*.

Discussion

Pets can have a positive influence on a child's development and self-esteem. Given the huge number of dogs in Canada, it is important for families and health care providers to be aware of the frequency and potential consequences of dog bites to children. We identified 287 dog bites to children over a 5-year period at 2 tertiary hospitals, a figure that undoubtedly significantly underestimates the overall incidence of dog bites in the study region. In a 1996 study of 16 Canadian hospitals (10 pediatric hospitals and 6 general hospitals), 1063 dog bites were identified in people ≤19 years old. Of these, 81% occurred in children 14 years old or younger, with a peak age range of 5 to 9 years. Our finding of a mean victim age of 7.4 years is in keeping with this report. However, in contrast to other studies reporting boys are more likely than girls to suffer a dog bite,[2,7–9] we found no gender difference.

Previous studies have reported younger children are at greater risk for severe bites,[2,3,7] a finding confirmed in our study. When young children interact with dogs their behaviour can be unintentionally provocative.[7] Although 1 study suggested that most bites are unprovoked,[4] young children should be supervised when interacting with dogs.

The only fatality in our study population was a 2-year-old boy who was attacked by a husky, known to the victim, while on a snowmobile with his parent. Between 1991 and 1994, an average of 1 Canadian per year died from dog bites. The hospitalization rate was 2.3 per 100 000, and children <10 years old were 4 times more likely to be hospitalized.[8] Between 1989 and 1994 in the United States there were 109 fatalities from dog attacks, predominately from pit bulls, Rottweilers and German shepherds; half of these occurred in children <10 years of age.[3]

In the only other Canadian study, the peak time and season of dog bites were 4 pm to 8 pm and June through August, respectively.[8] This temporal distribution is similar to US studies[7,10] and consistent with our findings. We found that June was the peak month for dog bites and 1730 was the median time for a bite to occur. The summer season and after school hours, are likely periods when children are more frequently outside and without parental supervision.

Stricter laws for "restricted dogs" (e.g., pit bull terriers and pit bulls†) and "vicious dogs" (any dog that has attacked or chased humans or animals without provocation) came into effect in the study region in 2001 (www.edmonton.ca/bylaws/C13145.do). These may have been factors in the downward trend of annual bite rates during the study period. There was scant documentation about the attacking dogs' containment; however other studies have reported that even with the use of leashes, chains and fences, children are still subjected to dog bites.[4,5] The ability of leash laws to minimize bites is further questionable given that many bites occur in the home.[4]

As reported in other studies,[2,7] most victims in our study were bitten by a known dog. This may be because pets of family and friends are more trusted, associated with more exposure time, or associated with less supervision.[7] We found that Rottweilers, and German shepherds were the breeds most likely to bite, consistent with previous research that reports that the majority of dog bites are from German shepherds, pit bulls, Rottweilers, Dobermans, terriers, huskies and chow chows.[4–6] Under Edmonton's bylaws, ownership of a Rottweiler, German shepherd, or pit bull requires registration under a special increased fee licence. Through registration, information can be shared with the owner regarding dangerous dogs and safety precautions. We were unable to capture data on animal gender or neutering. This information is important, as male and non-neutered dogs are known to be at increased risk for biting.[5] These factors should be considered by families selecting a pet dog, particularly families with small children.

Wound infection from a dog bite is a potentially serious problem. We found 16 of 287 children (5.6%) were documented to have signs of infection, usually occurring approximately 24 hours after the incident. This infection rate is likely an underestimate due to our lack of data on treat-

Table 4. Signs of infection and antibiotic administration recorded in the 287 charts reviewed

Variable	Signs of infection present, no. of patients: Yes	Signs of infection present, no. of patients: No	Total (and %)
Antibiotics prescribed			
Yes	8	205	213 (74.2)
No	8	66	74 (25.8)
Totals (and %)	16 (5.6)	271 (94.4)	

†For a comprehensive discussion of "dangerous dogs" and the definition of "pit bulls" go to www.cbc.ca/consumers/market/files/health/dangerousdogs/bylaws.html.

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ment provided at facilities outside the 2 study hospitals. A meta-analysis of 8 adult and pediatric randomized trials reported a 16% incidence of infection from dog bites.[11] Puncture wounds, especially to the hand, are at high risk for infection and should be treated with prophylactic antibiotics,[12] although this was not done in 3 of the cases in our study in which the patient received a puncture wound to the hand. Infection rates in both antibiotic-treated and untreated groups in our study may have been affected by inappropriate wound management. This is important because initial wound care involving irrigation and débridement can be more effective at preventing infection than prophylactic antibiotics.[13] In a double-blind prospective study, wound irrigation and débridement were effective at reducing the rate of infection from dog bites, and prophylactic antibiotics (penicillin) was only effective in high-risk wounds (puncture wounds and bites to the hand).[12] In another double-blind randomized study, wound infection rates were reduced if amoxicillin clavulanate was given to patients whose injury had occurred more than 9 hours earlier.[14] A meta-analysis found that 14 patients must be treated with antibiotics to prevent 1 infection (i.e., a number needed to treat [NNT] of 14).[11] Bacterial culture of wounds has not been found to be predictive of later infection.[12,13]

Conclusions

Although our findings are limited by a retrospective design and difficulty differentiating care lapses from a lack of documentation, this study clearly indicates that dog bites in Canadian children are common, often serious or even lethal, and not always managed ideally. Preventive discussion and public health contact is infrequently documented, and likely seldom occurs. We feel that to decrease the number and severity of dog bites in children a greater emphasis must be placed on prevention. Interested readers are encouraged to refer to other publications that discuss this in further detail.[3,7] We advise primary care physicians and ED staff to review dog bite risk factors and prevention strategies with families, thus achieving both primary and secondary prevention. Further, we believe public health notification should occur for all dog bites. This would facilitate the development of regional dog bite registries with information on incidence and dogs at risk, which in turn could guide policies such as leash laws and licensing. Public health is also able to provide follow-up on dog safety in the home and work with animal control agencies to observe dogs at risk of rabies.

In the ED, all dog bites should be properly cleaned, which includes high pressure irrigation and, if indicated, débridement. The dog's vaccination status should be determined and documented, as rabies is a rare but potential complication of dog bites. Tetanus is also a potential complication, therefore the child's immunization status should be determined and documented, and tetanus toxoid ± tetanus immune globulin administered as indicated. Routine wound culturing is not indicated, and prophylactic antibiotics should be administered for bites at high risk of infection, in particular puncture wounds, bites to the hand, and in patients who are immunocompromised or asplenic. Patients and families should be instructed on the signs of infection and advised to return if these occur.

Future research should be directed at the impact of prevention strategies on reducing the incidence of dog bites, and on the role of prophylactic antibiotics in preventing wound infection.

Competing interests: None declared.

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