Cat Bite Infections of the Hand: Assessment of Morbidity and Predictors of Severe Infection

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Purpose To assess the overall morbidity of cat bites to the hand and identify risk factors for hospitalization after such an injury.

Methods All patients recently treated at our institution for cat bite injuries to the hand were retrospectively reviewed. We identified 193 patients in a 3-year period between January 1, 2009, and December 31, 2011. Patient demographics, medical history, physical examination findings, laboratory values, and long-term follow-up data were collected. Univariate and multivariate statistical regression were used to analyze the data.

Results Thirty percent (n = 57) of patients with cat bites to the hand were hospitalized. The average length of stay for these patients was 3.2 days. Of the hospitalized patients, 67% (n = 38) underwent irrigation and debridement, with 8 patients requiring more than 1 operation. Complications were common among these patients. Risk factors associated with hospitalization included smoking, immunocompromised state, and location of bite over a joint or tendon sheath. Physical examination findings of erythema and swelling at presentation were also associated with increased risk of hospitalization. Time from bite to presentation, white blood cell count, erythrocyte sedimentation rate, and C-reactive protein values at presentation were not associated with hospitalization.

Conclusions Cat bite injuries to the hand can progress to serious infection. The treatment of such infections often requires hospitalization, intravenous antibiotic therapy, and operative treatment. Clinical findings suggestive of the need for hospitalization include location of the bite over a joint or tendon sheath, erythema, pain, and swelling. These findings should increase concern for a severe infection and warrant hospitalization and urgent consultation with a hand surgeon. *(J Hand Surg Am. 2014;39(2):286–290.*

Type of study/level of evidence Therapeutic III.

Key words Cat bite, animal bite, infection.

Animal bites account for approximately 1% to 2% of emergency room visits each year in the United States. The majority of these bites come from dogs (60%–90%), although a noteworthy percentage comes from cats (10%–15%).[1–3] Dog bites tend to be mechanically destructive as a result of a tearing action of blunt teeth and strong jaws. Cats, however, have very sharp teeth that can deeply penetrate soft tissues and inoculate bacteria into closed spaces, such as tendon sheaths, joints, and bone.[4,5]

The most common pathogen implicated in animal bites is *Pasteurella multocida*. *P. multocida is* a small, Gram-negative, non–spore-forming coccobacillus that is part of the normal oral flora of many animals including dogs and cats.[6,7] The bacteria are found in the oral cavity in 70% to 90% of healthy cats.[8,9] In a study by Westling et al,[10] 80% of infected cat bite

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wound cultures grew *Pasteurella* strains. Infected cat bites typically present as erythema surrounding the puncture wound(s). More severe infection is manifested by abscess formation, septic arthritis, tenosynovitis, osteomyelitis, and rarely, bacteremia.[6,11]

Cat bites have a propensity to occur in the upper extremity with 45% to 85% of bites involving the hand or wrist.[1,12] Cat bites to the hand pose a major risk of morbidity and can result in varying degrees of infection. Treatment options include observation alone, outpatient oral antibiotics, hospitalization for intravenous antibiotics, and if indicated, surgical irrigation and debridement. No widely accepted treatment algorithm for bites to the hand exists, so clinicians rely solely on judgment for each patient. Although early prophylactic antibiotic use following cat bites to the hand decreases infection rates from 28% to 2%,[13] predicting which patients will fail outpatient antibiotic therapy and require hospitalization remains a difficult. Previous studies have shown that hospitalization rates for cat bites range from 30% to 40%, with the indication for hospitalization being administration of intravenous antibiotics and possible surgical treatment.[4,6,14]

The literature lacks studies that focus on upper extremity bite injuries. The superficial proximity of tendon sheaths and joints in the hand places them at risk for inoculation by the sharp teeth of cats. Despite a benign outward appearance, a serious infection involving the tendon sheath or joint may be present. Anecdotally, definitive treatment may require multiple operations and prolonged antibiotic therapy, occasionally with major sequelae. We sought to review our experience with these injuries in order to determine the incidence of infections requiring hospitalization and operative treatment and to identify factors predictive of the need for such intervention.

METHODS

Patients treated at our institution for cat bite injuries to the hand were retrospectively reviewed over a 3-year period between 2009 and 2011. Study approval was obtained from the institutional review board. All patients presenting to the emergency department or primary care setting with a primary complaint of cat bite to the hand or wrist were included. Patients with bites proximal to the wrist were excluded. We identified 196 patients who fit these criteria. Three patients were excluded with bites from wild cats specifically identified as a lynx or bobcat. Patient demographics, medical history, physical examination findings, laboratory values, hospital course (if applicable), and long-term follow-up data were collected. Detailed location of the bite was noted when possible. No standard criteria or algorithm was used to determine the initial treatment of bites. Not all patients had complete data for each variable.

We examined multiple variables to identify those that are associated with hospitalization in the treatment of cat bite infection (Table 1). Descriptive statistics are reported as number and percentage or mean (SD) as appropriate. Univariate logistical regression was used to identify variables associated with hospitalization. Backward selection was used to identify the final multiple variable model, also using logistic regression. Observed risk is reported for each variable. An alpha level (P) of .05 was considered to be statistically significant.

RESULTS

Of the 193 patients, 69% were female and the mean age was 49 years. Approximately half of the patients at our institution presented initially to the emergency department (51%) with the others presenting first to primary care. Mean time from bite to presentation for medical care was 27 hours (range, 1−240 h). Thirty percent (n = 57) of patients with cat bites to the hand were hospitalized. The average length of stay for these patients was 3.2 days. Of the 193 patients, 36 were directly admitted upon presentation, 154 were treated as outpatients with oral antibiotics, and 3 were not treated. Twenty-one patients failed outpatient antibiotic treatment and were subsequently hospitalized (14% failure rate). Twelve of these 21 patients (57%) who failed outpatient antibiotics ultimately underwent irrigation and debridement. Twenty-six of the 36 (72%) patients admitted upon initial presentation underwent irrigation and debridement. Eight patients required more than 1 operation. Complications of infection were common and included abscess formation (n = 6), tendon involvement (n = 14), nerve involvement (n = 2), and loss of joint mobility following resolution of infection (n = 14) as noted in follow-up visits. Risk factors associated with hospitalization are shown in Table 1. Multivariate analysis identified the following as independent risk factors for hospitalization: location of bite over joint/tendon sheath versus soft tissue and physical examination findings of erythema and swelling. Time from bite to presentation, white blood cell count, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) values at presentation were

TABLE 1. Univariate and Multiple Variable Analyses of Risk Factors Associated With Hospitalization

Variable		Univariate		Multiple Variable*	
		Odds Ratio (95% CI)	*P*	Odds Ratio (95% CI)	*P*
Sex			.88		
Male	40/134 (30%)	1.0 (0.5–1.9)			
Female	17/59 (29%)	1.0 (reference)			
Diabetes			.36		
Yes	6/15 (40%)	1.7 (0.6–4.9)			
No	51/178 (29%)	1.0 (reference)			
Hypertension			.29		
Yes	23/67 (34%)	1.4 (0.8–2.7)			
No	34/126 (27%)	1.0 (reference)			
Smoking			**.04**		
Currently	**15/34 (44%)**	**2.2 (1.03–4.7)**			
Not currently	**42/159 (26%)**	**1.0 (reference)**			
Immunocompromised*			**.02**		
Yes	**6/9 (67%)**	**5.2 (1.3–21.6)**			
No	**51/184 (28%)**	**1.0 (reference)**			
Location of bite			**< .01**		**.02**
Over joint/tendon sheath	**38/87 (44%)**	**2.9 (1.5–5.8)**		**2.4 (1.2–5.1)**	
Metacarpal shaft/soft tissue	**17/81 (21%)**	**1.0 (reference)**		**1.0 (reference)**	
Fever			.54		
Yes	1/2 (50%)	2.4 (0.2–39.2)			
No	56/191 (29%)	1.0 (reference)			
Erythema			**< .01**		**.02**
Yes	**53/142 (37%)**	**7.0 (2.4–20.5)**		**4.0 (1.2–13.3)**	
No	**4/51 (8%)**	**1.0 (reference)**		**1.0 (reference)**	
Pain			**< .01**		**.07**
Yes	**53/148 (36%)**	**5.7 (1.9–16.8)**		**2.9 (0.9–9.4)**	
No	**4/45 (9%)**	**1.0 (reference)**		**1.0 (reference)**	
Swelling			**< .01**		**.04**
Yes	**50/120 (42%)**	**6.7 (2.8–15.9)**		**2.8 (1.1–7.6)**	
No	**7/73 (10%)**	**1.0 (reference)**		**1.0 (reference)**	
Drainage			**< .01**		
Yes	**9/11 (82%)**	**12.6 (2.6–60.2)**			
No	**48/182 (26%)**	**1.0 (reference)**			
Warmth			**.01**		
Yes	**13/25 (52%)**	**3.0 (1.3–7.2)**			
No	**44/168 (26%)**	**1.0 (reference)**			
Lymphangitis			**< .01**		
Yes	**8/11 (73%)**	**7.2 (1.8–28.4)**			
No	**49/182 (27%)**	**1.0 (reference)**			
ROM			**< .01**		
Decreased	**28/41 (68%)**	**9.1 (4.2–19.8)**			
Normal	**29/152 (19%)**	**1.0 (reference)**			

(Continued)

TABLE 1. Univariate and Multiple Variable Analyses of Risk Factors Associated With Hospitalization (Continued)

Variable		Univariate		Multiple Variable*	
		Odds Ratio (95% CI)	*P*	Odds Ratio (95% CI)	*P*
WBC			.04		
Elevated (> 10.5)	12/12 (100%)	∞ (1.1−∞)			
Normal	40/49 (82%)	1.0 (reference)			
ESR			.76		
Elevated (> 22.0)	6/7 (86%)	0.7 (0.1−8.7)			
Normal	18/20 (90%)	1.0 (reference)			
CRP			.50		
Elevated (≥ 8.0)	19/20 (95%)	2.7 (0.2−49.5)			
Normal	7/8 (88%)	1.0 (reference)			

95% CI, 95% confidence interval; ROM, range of motion; WBC, white blood cell.
Bold entries represent the variables that are predictors for hospitalization in univariate or multivariate logistic regression analysis.
*The multiple variable model did not include 25 patients with an unspecified bite location. The variables considered for inclusion in this model included current smoker status, bite location, presence of erythema, presence of pain, presence of swelling, and presence of warmth.

not identified to be associated with increased risk of hospitalization (Table 1).

DISCUSSION

Our study indicated that middle-aged women were the most common demographic to sustain cat bites. The hospitalization rate of 30% found in our cohort was similar to that of previous studies.[4,12,15] There were no differences in rates of hospitalization or outpatient treatment failure between patients who presented to the primary care setting or the emergency department.

Mean time from bite to presentation was 27 hours and did not significantly vary between hospitalized and nonhospitalized patients. A previous study, which included both cat bites and scratches to the entire body, determined that longer time from injury to presentation to the emergency department was associated with development of infection.[12]

Most patients were treated successfully with outpatient antibiotics (86% success rate). The most commonly used agent was amoxicillin-clavulanate. Some patients failed outpatient antibiotic therapy and subsequently presented with worsening symptoms and were hospitalized (14%). The fact that a noteworthy number of patients failed outpatient treatment emphasizes the importance of careful and detailed evaluation of patients upon initial presentation. If risk factors associated with need for hospitalization are present, this should guide initial treatment choices. One limitation of our study is that a hand surgeon did not evaluate most patients who were treated as outpatients; therefore, evaluation and treatment choice are less consistent.

A prospective study evaluated patients presenting to the emergency department with cat bite/scratch wounds over a 2-year period.[12] The investigators found that several factors were associated with infection, including older age, longer time until emergency department treatment, attempting wound care at home, wounds inflicted by pet cats, having a more severe wound, and having a deeper wound. We feel that depth and severity of a cat bite wound is difficult to determine. Location of bite relative to anatomical structures is much easier to reliably categorize. In our series, patients with bites located directly over the wrist or any joint in the hand had a significantly higher risk of hospitalization than those with bites over soft tissue. In our analysis of bite location and in an attempt to make the results more valuable, 25 patients were excluded owing to unspecified bite location.

A careful physical examination should be performed when patients present with cat bite to the hand. Lymphangitis was present in 11 patients; 8 of these patients were hospitalized, and 4 required surgery. Although no statistical correlation could be made between lymphangitis and hospitalization owing to small sample size, it is clear that presence of lymphangitis is a concerning sign. Erythema and swelling were both independently significant predictors of hospitalization. When patients present with a combination of these findings, there should be a low threshold for aggressive treatment.

Laboratory studies were ordered in approximately 15% of patients in our series, which most commonly included white blood cell count, ESR, and CRP value. Mean ESR was actually lower in the hospitalized group than in the nonhospitalized group. The CRP value seemed to be more consistently elevated in hospitalized patients, but no laboratory values reached statistical significance in predicting need for hospitalization. Laboratory studies were ordered almost exclusively in patients that were eventually hospitalized; thus, these variables are biased, making interpretation of the results difficult.

Cultures were available in 50 patients. The most commonly isolated organism was *Pasteurella multocida* (n = 19), followed by skin flora (n = 13). *P. multocida* deserves special attention. This small, nonmotile, aerobic or facultatively anaerobic Gram-negative Coccobacillus is one of the most aggressive pathogens isolated from the saliva of 70% to 90% of cats.[8,9] The acute onset of cellulitis, lymphangitis, and serosanguineous or purulent discharge from hand wounds 12 to 24 hours after cat bite should suggest *P. multocida* infection.[7]

Two patients underwent primary closure in the emergency department and were treated with outpatient antibiotics. Both patients subsequently returned a day later with worsening infection and were hospitalized. Garbutt et al[16] found no difference in infection rate between sutured and non-sutured animal bite wounds. Wongworawat and Schnall[17] recommend leaving animal bite wounds open for secondary healing. Philipsen et al[15] reported that 2 out of 3 cat bites that were primarily closed subsequently required hospitalization, and several other studies also caution against primary closure of bite wounds.[2,6,15,18,19] We caution strongly against closure of any cat bite wound. An exception is after incision and drainage with debridement when deeper structures are exposed, such as tendon, bone, joint, or neurovascular structures. We loosely approximate the skin in this setting to prevent loss of domain, which can be defined as contracture of skin and soft tissues with an open wound defect that cannot be closed primarily. This enables delayed primary wound closure once the infection is adequately treated.

Time to resolution, which was defined by discontinuation of clinic follow-up with a hand surgeon, was longer in the hospitalized group (30 d vs 13 d). Reported long-term sequelae in 14 hospitalized patients were decreased range of motion and marked tissue loss requiring soft tissue flap. These sequelae demonstrate morbidity in those patients with infections requiring hospitalization.

Our study has several weaknesses. Data recording at time of patient evaluation was not standardized or objective. We attempted to minimize the effects of this by excluding certain ambiguous data points from our statistical analysis, such as location of bite. Also, there were no standardized protocols for initial treatment choice, antibiotic choice, or treatment of hospitalized patients. A prospective study in which patients are evaluated and treated in a standardized and objective manner would be helpful.

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