

## ORIGINAL ARTICLE

# CAT BITES OF THE HAND

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**Background:** Cat bites are the second most common mammalian bites. Cat bites of the hand in particular represent a potentially devastating problem in terms of wound infection and long-term disability if not treated appropriately. The purpose of the present study is to give an overview of demographics, management and follow up of the patients with cat bite injuries of the hand treated at the Royal Hobart Hospital.

**Methods:** Retrospective and prospective data of all patients with cat bites of the hand seen at the Royal Hobart Hospital for a period of 3 years (January 2000 to April 2003) were collected. Demographics, anatomical site, presentation, assessment, investigations, management and follow up of the patients with this type of injury were analysed. The accuracy of the obtained data was checked by analysing questionnaires returned by our patients.

**Results:** Forty-one patients were treated for cat bites of the hand. Twenty-six were managed in the department of emergency medicine and 15 were admitted and managed by the department of plastic and reconstructive surgery. Five of 15 admitted patients required surgery. Compliance was not a major problem in our study as very few patients were lost to follow up. Almost all patients had close follow up and extensive hand physiotherapy achieving overall good long-term results. Out of 39 patients who were sent questionnaires only one indicated long-term problems with the hand (response rate 46%).

**Conclusion:** Appropriate early treatment of cat bites of the hand is the key to success. Treatment with antibiotics, surgical drainage, debridement and copious irrigation, and use of corticosteroids in some cases, proved to be effective. Hand elevation and intensive physiotherapy after a short period of immobilization is critical. We believe that prophylactic antibiotics should be given even in case of a minor infection following cat bites of the hand. Clear guidelines for clinical recognition of infection, hospital admission and management are provided in our study.

**Key words:** antibiotics, cat bites of the hand, corticosteroids, hand physiotherapy, *Pasteurella multocida*.

Abbreviation: PIP, proximal interphalangeal.

## INTRODUCTION

Bite wounds account for approximately 1–2% of all visits to the emergency department.<sup>1,2</sup> Most commonly, animal bite injuries are inflicted by dogs (80–90%,<sup>3,4</sup>). Cat bites are the second most common type of bite<sup>5–7</sup> making up 5–15% of all reported animal bites.<sup>1,8,9</sup> Cat bite injuries can be devastating in terms of infection and permanent disability if not treated appropriately and expeditiously.

The upper extremities, especially the hand, are particularly vulnerable to cat bite wounds. Of all cat bite cases, the hand is involved 45–63% of the time.<sup>10,11</sup> Infection rates have been reported to range between 30% and 50%, which is double the rate for dog bites.<sup>8,9,12,13</sup> Veitch and Omer report that infective complications of cat bite injuries to the hand represent a total of 1% of all patients hospitalized with hand infections.<sup>14</sup> This is likely due to the fine, sharp teeth of cats that are capable of penetrating skin, tendons and their sheaths, joint capsules and bones, resulting in abscess formation, tenosynovitis, septic arthritis and osteomyelitis.

The issue of cat bites of the hand has not previously been examined in Australian medical literature and only partially investigated worldwide despite it being a potentially significant problem. The purpose of our study is to overview the occurrence of cat bite injuries to the hand in Australia, with Southern Tas-

mania as an example. The main referral hospital in this area is Royal Hobart Hospital, which services a population of approximately 250 000. We analysed demographic data, patterns of presentation and reasons for admission, investigations, surgical and non-surgical modalities of management, complications and follow up. We propose clear guidelines for admission and management of patients with this type of injury using our own experience in conjunction with the data published in medical literature for the last two decades.

## METHODS

Retrospectively and prospectively collected data for the period from January 2000 until April 2003 is analysed. All cases of cat bite injuries of the hand presenting to the department of emergency medicine and/or admitted to the department of plastic and reconstructive surgery within this period of time were analysed using medical record review and audit of the hospital database.

There were 41 patients identified including 15 admitted as inpatients. All (except two deceased patients) were sent letters and a short questionnaire to confirm accuracy of the collected data.

Gender, age, anatomical site of injury, symptomatology and reasons for admission, investigations (blood tests, microbiology and radiology results), antibiotic therapy, surgical and non-surgical management, length of hospital stay, hand physiotherapy, complications and follow up of the patients were evaluated.

An extensive medical literature review was performed. Obtained data and treatment practices at the Royal Hobart Hospital were compared with current international practices.

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## RESULTS

### Demographics

We identified 41 patients with cat bite injury to the hand. Fifteen were men and 26 were women (ratio 1:1.7). Median age was 37 years for men (range 11–77 years) and 36 for women (range 15 months to 85 years).

Fifteen of 41 patients (37%) required admission and five patients (12%) required surgical intervention.

### Anatomical site

Twenty-one patients (51%) sustained bites to the left hand. The right hand was involved in 16 cases (39%). Four patients (10%) had been bitten on both hands. The middle and index fingers were the most common sites for cat bites (both dorsal and palmar surfaces). However, injuries to the other parts of the hand were also common.

### Signs and symptoms

Most of the patients who were seen in the department of emergency medicine but did not require admission complained of pain, erythema and swelling around the puncture wounds. One patient presented with mild lymphangitis without lymphadenitis and one other had a small pus collection. Most of the patients had decreased range of movements of the injured fingers due to pain and swelling. None of the patients from this group was febrile.

Patients requiring admission presented with more swelling, pain and erythema, localized warmth and inability to move fingers. Two patients presented with overt abscesses.

### Investigations

#### Radiology

Eight of 46 patients had hand X-rays taken (18%). As expected, none of the initial X-ray films showed changes of osteomyelitis or septic arthritis (e.g. periosteal reaction, bone destruction or joint space changes). It is important to note that the initial X-ray of one patient with signs of septic arthritis (proximal interphalangeal (PIP) joint of his right index finger) did not support the clinical diagnosis. The X-ray films were repeated 3 days later, and showed osteolysis of articular margins consistent with septic arthritis. This suggests that X-ray investigation may be an inaccurate diagnostic tool, particularly in early period following injury. Clinical impression should take precedence.

One patient had an ultrasound examination to exclude tenosynovitis. Another patient had nuclear medicine scan that showed inflammatory and osteolytic changes of a metacarpophalangeal joint consistent with septic arthritis.

#### Microbiology

Only one of the patients seen in the department of emergency medicine and not admitted to the ward had wound swab taken. Seven out of 15 admitted patients (47%) had wound swabs taken and sent for microscopy, culture and sensitivities. Three of seven cultures showed no growth, three cultures grew *Pasteurella multocida*, either alone or in combination with coagulase negative *Staphylococci* and Gram negative rods, and one culture grew *Streptococcus milleri* and mixed anaerobes. In all cases microorganisms were sensitive to penicillins (amoxicillin alone or in combination with clavulanic acid) and resistant to gentamicin.

#### Blood tests

No blood tests were done on patients not requiring admission to hospital. Of the admitted patients, three blood cultures were sent to the laboratory. None of the blood cultures was positive for pathogenic microorganisms. Fourteen of 15 admitted patients had a full blood count examination. Only in four cases was there was an elevation of the white cell count (ranging from 11.3 to 14.9) with neutrophilia. Inflammatory markers (ESR and CRP) were elevated in almost all cases when examined (five out of six).

#### Antibiotic therapy

Only five of 41 patients (12%) did not receive treatment with antibiotics. They either did not wait for the supply prescribed or had superficial bites not deemed to require antibiotics. The majority of patients with cat bites of the hand received antibiotic treatment. Oral antibiotics were prescribed to patients who did not need admission. Some received a single dose of parenteral antibiotic. The most often prescribed antibiotic was amoxicillin/clavulanate.

All 15 inpatients received i.v. antibiotics. Six patients received Benzylpenicillin with Flucloxacillin, four Ceftriaxone with Metronidazole, four Ticarcillin and clavulanic acid and one Imepenem. In all cases antibiotic therapy in conjunction with surgical treatment (when indicated) was effective in controlling infection.

#### Surgical management

Five patients required surgical treatment in operating theatre. Three required a single operation, one had two and one required three operations. Surgery involved exploration, debridement and irrigation. Surgical wounds were initially left open unless surgery involved joints.

Of the five, two patients had wound closure under local anaesthetic at a later stage. One had arthrotomy, irrigation and direct closure of the wound over the proximal interphalangeal joint. One patient underwent three arthrotomies, irrigations (last time with solution containing gentamicin and hydrocortisone) and closure of the wound. The final patient had extensive debridement of the infected necrotic areas during first operation and split skin grafts to the debrided areas as a second procedure. The other measures included immobilization of hand in plaster or bulky dressing, arm elevation and ice packs to decrease swelling. Another important and very effective measure of reduction local tissue oedema was administration of corticosteroids. Four of 15 surgical patients had significant hand swelling following cat bites. Two of them received this treatment in conjunction with surgery and two without surgery. The administration regime included either oral Prednisolone with starting dose of 60 mg daily and daily tapering dosage in three patients or 100 mg of Hydrocortisone intravenously with subsequent change to oral Prednisolone for another. In all four cases the results were excellent.

#### Hospital stay

Of 15 patients admitted to the hospital, one was transferred to a private hospital. The length of stay varied from one day to nine days. Mean stay in hospital was 3.8 days. The longest stay (9 days) was recorded for three patients. Two of them had septic arthritis. The third patient had an extensive debridement of the left forearm and hand necrotic ulcers requiring subsequent split skin grafting.

#### Follow up

Of the 26 patients seen in the department of emergency, only one was referred to the plastics outpatient clinic, rapidly improved

and was subsequently discharged. The remainder were followed up by their general practitioners.

Of those managed as inpatients, all were for review in the plastics outpatient clinic. Two patients did not attend the clinic. Eleven patients attended clinics as planned and were discharged once improved. One patient is currently under review. No patient discharged from our clinic has returned for further follow up.

The outcomes for patients with cat bites managed by our unit was checked by postal questionnaires. The information pertaining to any further treatment out of the hospital (for example by a general practitioner or hand therapist), total recovery or permanent residual disability, and duration of recovery was sought.

## DISCUSSION

The majority of patients suffering cat bite injuries to the hand were middle-aged women. The male : female ratio of 1.0:1.7 is similar to other reported studies (1:1.5 in a study conducted by Dire<sup>10</sup>). The median age of patients in our study is younger than that reported by some other authors and it is explained by the fact that there were three patients (two women and one man under the age of 2 years old

More patients sustained bites to the left hand than to the right, with middle and index fingers being the commonest site of injury. Peeples *et al.* showed in their series that animal bites to the dorsal surface of the hand were seen more often than to the fingers.<sup>15</sup> However, they did not differentiate between dog and cat bites and their respective anatomical distributions.

Pain, erythema and swelling around the puncture wounds were the usual presenting symptoms. Other clinical features encountered were local elevation of temperature, lymphangitis, lymphadenitis and pus collection. Generalized fever was not encountered. Infection is the most common complication of cat bites to the hand. It was reported that 20–50% of cat bites become infected.<sup>8,16–18</sup> Therefore, the criteria for infection warrant special attention. In our study we adapted criteria described by Talan *et al.* 1999.<sup>19</sup> A wound is considered to be infected if it meets one of the three major criteria or four of five minor criteria.

The major criteria are:

- fever
- abscess
- lymphangitis.

The minor criteria are:

- erythema that extends more than 3 cm from the edge of the wound
- wound site tenderness
- swelling
- purulent discharge
- white cell count over 12 000 (per cubic mL of blood)

For hospitalization we suggest criteria used by Goldstain.<sup>1</sup> They include:

- severe cellulitis
- systemic manifestations of infection (e.g. fever, vomiting, confusion)
- evidence or strong clinical suspicion of bone, joint, tendon or nerve involvement
- rapid spread of infection (within 24–48 h)
- absence of response to oral or outpatient therapy
- under certain circumstances, patients regarded unreliable or incompetent

In addition to the above criteria, we would admit young children with injuries following cat bites for pain relief and observation for 24–48 h.

Clinical evaluation of a cat bite wound plays a significantly more important role than do investigations. Radiological investigations had minor diagnostic value during initial presentation. None of the X-ray films showed signs of bone or periosteum involvement in an infective process in the early stages. In our opinion, X-ray and ultrasound investigations should be reserved for cases with clinical suspicion of osteomyelitis, septic arthritis or tenosynovitis. These investigations are important for checking a progress of confirmed cases of deeper structure injuries or infections.

On the other hand, microbiological evaluation is essential. Wound swabs (or in some cases small tissue sample) should be sent for microscopy, culture and antibiotic sensitivity testing whenever a clinically infected wound is encountered. Results of Gram stain microscopy may become available within 2–4 h after collection. Gram-positive cocci most commonly present are *Staphylococcus*, *Streptococcus* or *Diphtheroid* species. The most common Gram-negative pathogen is *P. multocida*. Results of cultures and sensitivities are usually available only after 48 h of incubation.

*P. multocida* deserves special attention. This a small, non-motile, Gram-negative Coccobacillus that can be aerobic or facultatively anaerobic. *P. multocida* is one of the most aggressive pathogens that was isolated from the saliva of 70–90% of cats.<sup>20,21</sup> Talan *et al.* showed that *P. multocida* subspecies *multocida* and *septica* were the commonest isolates of cat bite wounds.<sup>19</sup> This was confirmed in our study. Three of seven wound swabs grew *P. multocida* (43%). The other pathogens were less common (*S. milleri*, coagulase negative *Staphylococci* and mixed anaerobes were found one of each in other cultures). The acute onset of cellulitis, lymphangitis and sero-sanguinous or purulent discharge from hand wounds 12–24 h after cat bite or scratch should suggest *P. multocida* infection.<sup>22</sup> Moderate to severe pain is a common complaint. If treatment is inadequate, localized cellulitis may extend to involve deeper structures. Sepsis and multiple organ failure may ensue if progression of infection is not halted.

Early aggressive treatment is suggested and antibiotic therapy must be initiated prior to availability of microbiology results. Delayed administration of antibiotics for 48 h awaiting bacteriological cultures and sensitivities is irrational and detrimental. The combination of antibiotics can be altered according to the sensitivity results at a later stage. Microbiological findings suggest that empirical antibiotic therapy for cat bites should be directed against pasteurella, streptococci, staphylococci and anaerobes.<sup>19</sup> The combination of i.v. Benzylpenicillin and Flucloxacillin is effective in most cases in conjunction with surgical treatment when indicated. The use of i.v. Ticarcillin and clavulanic acid alone in three of our patients proved to be equally effective (but more expensive). For patients allergic to penicillin we suggest to use Ceftriaxone with Metronidazole.

Use of prophylactic antibiotics for small wounds following cat bite to the hand showed to be effective in the reduction of the rate of infection from 28% to 2%.<sup>23</sup> Amoxicillin/clavulanate was shown to be more effective than other antibiotics in the prevention of infection after animal bites.<sup>24</sup>

The use of antibiotics alone when abscess or collection exist is ineffective. Five of 15 patients admitted to our ward with cat bites

of the hand underwent surgery (33%); similar to figures shown in other studies.<sup>15</sup> The other two inpatients had surgical drainage of hand collections either in the department of emergency or by GP prior to their presentation to RHH.

We did not encounter a case of cat scratch disease. Although the name implies a scratch as the mode of spread, it may follow a bite or a lick from an infected cat. The causative organism is a gram-negative bacillus, *Bartonella henselae*, and the diseases is usually a benign, self limiting condition in immunocompetent patients. After an incubation period of 3–30 days, the disease starts as a small papule or pustule and progresses to regional lymphadenitis. Fifty per cent of patients have systemic symptoms such as headache, fever and arthralgia. *B. henselae* is sensitive to Rifampicin, Ciprofloxacin, Gentamycin or Trimethoprim/Sulphamethoxazole.

In our series the main indication for surgery was for drainage of deep infection rather than for repair of injury to deeper structures. Surgical treatment consisted of surgical drainage of abscesses, cautious debridement of devitalized tissues and copious irrigation (approximately 500 mL of sterile normal saline solution). Wound irrigation (especially under high pressure) has been shown to reduce significantly subsequent wound infection rates.<sup>25</sup> Two of the patients with clinically apparent septic arthritis required arthrotomies and joint washouts.

We recommend that hand wounds are not closed at the time of primary surgery. The wounds are reviewed at 24–48 h. We use delayed primary closure for the wounds with signs of improvement. For patients unwilling to have further surgery or small wounds healing by secondary intention is a recommended option. Our approach includes a primary closure of the interphalangeal or metacarpophalangeal joints following copious washout.

Use of corticosteroids to achieve rapid decrease in wound swelling in conjunction with limb elevation was used in our study and proved to be effective. Immobilization of the hand in a plaster splint in a position of function was routinely done for 48–72 h. Aggressive hand physiotherapy was commenced thereafter.

Compliance was not a major problem in this series. We did not have any cases of self-discharge from the hospital. The majority of patients attended plastics outpatient clinics and hand physiotherapy sessions. Almost all of them achieved full range of hand movement by the time of discharge from the clinic. Only one of the questionnaire respondents indicated long-term problems with the hand.

We have shown that early aggressive treatment with antibiotics, corticosteroids and surgery when necessary, hand elevation and supervised hand therapy after a short period of immobilization, proved to be effective in management of cat bites of the hand. Close follow up and careful review of wound progress was an important contributing factor in the achievement of good results in terms of return to normal function in almost all of our patients. Unfortunately we were unable to compare our results with those of other units regarding outcomes of hand cat bite injuries as there is no published data available. We believe that management principles in this type of injury by the department of plastic and reconstructive surgery of the Royal Hobart Hospital should be adopted by the other medical institutions or surgical teams in Australia or overseas.

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## REFERENCES

1. Goldstain EJC. Bite wounds and infection. *Clin. Infect. Dis.* 1992; **14**: 633–40.
2. Callaham M. Prophylactic antibiotics in common dog bite wounds: a controlled study. *Ann. Emerg. Med.* 1980; **9**: 140–4.
3. Rest J, Goldstain EJ. Management of human and animal bites. *Emerg. Med. Clin. North Am.* 1985; **3**: 117–26.
4. Marr J, Beck A, Lugo J. An epidemiologic study of the human bite. *Public Health Rep.* 1979; **94**: 514–21.
5. Elenbaas RM, McNabney WK, Robinson WA. Evaluation of prophylactic oxacillin in cat bite wounds. *Ann. Emerg. Med.* 1984; **13**: 155–7.
6. Callaham ML. Human and animal bites. *Top. Emerg. Med.* 1982; **11**: 1–15.
7. Elenbaas R, McNabney WK, Robinson W. Prophylactic oxacillin in dog bite wounds. *Ann. Emerg. Med.* 1982; **11**: 248–51.
8. Agahbabian RV, Conte JE. Mammalian bite wounds. *Ann. Emerg. Med.* 1980; **9**: 79–82.
9. Wiley JF. Mammalian bites: review of evaluation and management. *Clin. Ped.* 1990; **29**: 283–7.
10. Dire DJ. Cat bite wounds: risk factors for infection. *Ann. Emerg. Med.* 1991; **20**: 973–9.
11. Love DN, Malik R, Norris JM. Bacteriological warfare amongst cats: what have we learned about cat bite infections? *Vet Microbiol.* 2000; **74**: 179–93.
12. Goldstain EJC. Management of human and animal bite wounds. *J. Acad. Derm.* 1989; **21**: 1275–9.
13. Dire DJ, Hogan DE, Riggs MW. A prospective evaluation of risk factors for infection from dog bite wounds. *Acad. Emerg. Med.* 1994; **1**: 258–66.
14. Veitch JM, Omer GE. Case report: treatment of catbite injuries of the hand. *J. Trauma* 1979; **19**: 201–2.
15. Peeples E, Boswick JA, Scott FA. Wounds of the hand contaminated by human or animal saliva. *J. Trauma* 1980; **20**: 383–9.
16. Helm EB, Stille W. Uber die Erreger bei infizierten Tierbissen. *Munch. Med. Wochenschr.* 1972; **114**: 922.
17. Douglas LG. Bite wounds. *Am. Fam Physician* 1975; **11**: 93.
18. Kizer KW. Epidemiologic and clinical aspects of animal bite injuries. *JACEP* 1979; **8**: 134.
19. Talan DA, Citron DM, Abrahamian FM, Moran GJ, Goldstain EJ. Bacteriologic analysis of infected dog and cat bites. *N. Engl. J. Med.* 1999; **340**: 85–92.
20. Weber DJ, Wolfson JS, Swartz MN. Pasteurella multocida infections: reports of 34 cases and review of the literature. *Medicine* 1984; **63**: 133–54.
21. Lucas J, Bartlett D. Pasteurella multocida infection in the hand. *Plast. Reconstr. Surg.* 1981; **67**: 49–53.
22. Arons MS, Fernando L, Polayes IM. Pasteurella multocida – the major cause of hand infections following domestic animal bites. *J. Hand Surg.* 1982; **7**: 47–52.
23. Medeiros I, Saconato H. Antibiotic prophylaxis for mammalian bites (Cochrane Review). In: *The Cochrane Library* Issue 2. Oxford: Update Software, 2003.
24. Brakenbury PH, Muwanga C. A comparative double blind study of amoxicillin/clavulanate vs placebo in the prevention of infection after animal bites. *Arch. Emerg. Med.* 1989; **6**: 251–6.
25. Rodeheaver GT, Pettry D, Thacker JG. Wound cleansing by high pressure irrigation. *Surg. Gynecol. Obstet.* 1975; **141**: 357–62.