ORIGINAL ARTICLE

CONTENTS

Outcomes of treatment of cat-bite injures

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ABSTRACT

Aim: The objective of the study was to analyze the results of treatment of hand cat bite wounds in one centre with a hand surgery profile, within one year.

Materials and Methods: Fifteen patients, 9 women and 6 men, aged a mean of 43 years, with hand infections caused by cat bites were treated. All patients were admitted to the hospital, and the treatment consisted of a wide incision in the area of infection. The results were evaluated in 13 patients after an average 1.8 years from the start of treatment.

Results: Most patients did not complain of hand pain at all. Two patients had a slight deficit in finger flexion, and one had incomplete wrist mobility. All patients regained good grip strength, and the dexterity of the hands, and assessment with the qDASH questionnaire revealed almost the same function as that of a healthy hand (mean 8.4 points). One patient developed necrosis of a bitten finger. The most dangerous infections were caused by the *Streptococcus pyogenes* bacterium. The total treatment time was 2.3 months in average. All wounds were sutured after the inflammation had subsided. In 5 patients, treatment was prolonged due to aseptic inflammation after surgical wounds had healed.

Conclusions: Cat bites can be the cause of severe infections and serious complications. Early, wide incision of the area showing fear of infection and intravenous antibiotic therapy allow the disease to be controlled, complications are prevented and a good treatment result is achieved.

KEYWORDS: cat bite; hand phlegmon; surgical treatment; microbiological profile; outcome assessment.

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INTRODUCTION

Hand wounds caused by bites by dogs and cats are relatively common and almost every day bitten patients are seen in emergency departments. The number of dogs kept at home in the author's country is estimated at 8 million, the number of cats at 7 million, with an increasing tendency. In addition, there is an even more unspecified number of stray animals (without an owner). Literature provides estimates on the number of bite wounds inflicted by animals in different countries. In the United States, there are about 1-2 million bites by dogs and about 400 thousands bites by cats per year, which is about 200 bite wounds per 100,000 inhabitants, per year [1]. In Europe, on the other hand, it is estimated that there are 175-740 animal bites per 100,000 inhabitants per year. In Germany, there are about 35,000 bites per year by dogs and cats with an owner (registered) and about 1 million by stray animals [2]. There is no such data in the author's country, however people bitten by dogs or cats present every day to the emergency department of the hospital where the author works (large facility). Of this number, at least 1-2 patients per week require hospitalization due to a deep infection requiring incision and drainage. So this is a relatively serious problem. Dog bites account for about 70-80% of all events, followed by bites and scratches by cats (5-15%), and human bites (3-23%) [3]. The victims are usually dog or cat owners and people who work with animals, such as veterinarians and farmers, on whose farms the animals are very often kept. Hands are the most common bite site in adults and older children, while children < 10 years of age are more often bitten in the head and neck [3]. Bite wounds have been classified (as well as burns) depending on the depth and presence of tissue loss or necrosis [2]. A three-level grading divides bitten wounds into superficial (1°), deep (2°) and complicated (3°) wounds (Table 1). This classification is not as important as in burns and has no major impact on practice, however, it can be useful in record-keeping, research and outcome assessment. Most bite wounds encountered in practice are 1st degree wounds.



Fig. 1a. Hand view 12 hours after being bitten by a cat. The bite site is marked with an arrow
Source: Own materials



Fig. 1b. Swelling and redness of the dorsal side of the metacarpal in the patient from Figure 1a
Source: Own materials



Fig. 1c. Hand view 24 hours after being bitten by a cat. The bite site is marked with an arrow
Source: Own materials



Fig. 2a. Incisions in the patient from Figure 1c. Note pus outflow from the wounds
Source: Own materials



Fig. 2b. Four days after the incision in the patient from Figure 1a
Source: Own materials

Cat bites are considered worse than dog bites. Cats have thin and sharp teeth, causing puncture wounds. Soon after being bitten, the organisms on the teeth and in saliva are introduced relatively deep into the subcutaneous tissue, where they have good conditions for multiplying. A puncture bite is a closed wound where there is no outflow of contents, which additionally promotes the development of infection. Data from the literature indicate a statistically significantly higher risk of infection of the cat bite wounds compared to the dog bite wounds [4-6]. Some wild and farmed animals, such as squirrels, ferrets, chinchillas and foxes, also have teeth similar to cats, but such bites are rare.

For the above reasons, it is recommended to make a primary incision in bite wounds inflicted by cats.

The author's institution deals with a lot of hand bites caused by dogs and cats. Treatment of such injuries is relatively difficult and often long-lasting, which in some cases is the result of bad initial care conducted by emergency and family doctors. Patients with diffuse hand phlegmons are frequently admitted to the hand surgery clinic a few days after the bite, requiring surgical treatment, hospitalization and intravenous antibiotic therapy.

AIM

The aim of this study was to analyze the results of the treatment of cat bites to the hand carried out in dedicated hand surgery centre.

MATERIALS AND METHODS

MATERIALS

In 2023, 15 patients, 9 women and 6 men, aged 43 years (range 27-64) with hand infections caused by cat bites were treated in the author's institution. Table 2 summarises the demographic and clinical data of this patient population. In 12 cases, the bite was caused by a cat's own or known, and in 3 cases by an unknown animal. Of these 3 cases, in one the cat was captured and handed over for observation, and the other 2 cats escaped. In 9 patients, the wound involved the left, and in 6 the right hand. The fingers were the most common bite site - 7 cases, followed by the dorsal metacarpal side - 4, the palmar metacarpal side - 2 and the wrist - 2 (Figs. 1 a-c). The time from the bite to presenting to the hospital was a mean of 14 hours (range 8-76). Two



Fig. 3a. Extensive incisions on the metacarpal and forearm in the patient after biting the index finger. *Streptococcus pyogenes* infection
Source: Own materials



Fig. 3b. Index finger necrosis 3 days after bite; The patient in Figure 3a
Source: Own materials



Fig. 3c. View of the patient's hand from Figures 3 a and b, four days after the amputation of the index. Note full finger flexion and secondary wound closure
Source: Own materials



Fig. 3d. View of the patient's limb from Figure 3a, two days after closure of the wounds
Source: Own materials

patients (13%) reported only redness and swelling in the bite area, and 13 (87%) had signs and symptoms of phlegmon involving the hand and forearm at the time of reporting (Figs. 1 a-c). Two patients had the hand and forearm affected, and one patient had an entire upper limb, up to the middle of the arm.

TREATMENT IN THE SURGICAL WARD

All patients with signs and symptoms of the diffuse infection (phlegmon) were given surgery with extensive incision(s) and were admitted to the hospital. Two patients with superficial inflammation were given an antibiotic and released home, but the next day they came back because of spread of infection. These patients were operated on and admitted to the hospital. Patients were operated on the day of reporting to the hospital, without undue delay. Prior to surgery, they received an intravenous antibiotic: 1.2 g of amoxicillin with clavulonate in 12 cases, and 0.6 g of clindamycin in 3 cases. All patients received tetanus prophylaxis upon admission.

Nine patients were operated on under brachial plexus block anaesthesia and with a tourniquet on the arm, and 6 in WALANT (Wide-Awake Local Anaesthesia With no Tourniquet). In 8 cases of severe phlegmon, the operation was performed in the operating room in the theatre, and in 7 cases of local infections - in the procedure room (in the emergency department or at the surgical ward). The length of the incisions on the fingers was 2-3 cm, and on the metacarpus about 4 cm (Figs. 2 a, b). The incisions on the forearm and arm were the longest, even 10-15 cm. Incisions were made on the palmar and dorsal sides of the fingers and metacarpus, as signs of infection were usually seen on both sides. In four patients, infection involved the hand and forearm, and in 2 it reached the upper arm. Bacterial cultures in these patients revealed streptococcal (*Streptococcus pyogenes*) infection. In these cases, long incisions were made through the entire affected area of the extremity (Fig. 3 a). In 12 cases, inflammatory infiltration of soft tissue was found at the incision, without the presence of a pus, and in 3 cases pus collection was present (Fig. 2 a). In all cases, material was collected for culture. Haemostasis was achieved by compression or by diathermy. In most cases, a rigid drain was inserted into the wound, in the form of a gutter, which facilitated the drainage of the contents from the wound and prevent-



Fig. 4a. View of another patient's wrist and forearm 2 days after wounds closure. *Streptococcal phlegmon*
Source: Own materials



Fig. 4b. Stitched wounds on the forearm and arm. The same patient as in Figure 4 a
Source: Own materials



Fig. 4c. The patient shown in the figures 4 a, b, at follow-up examination at 2 years. The wounds in the forearm are almost invisible, they were marked with a pen
Source: Own materials



Fig. 4d. Full flexion of the patient's fingers from Figure 4c
Source: Own materials



Fig. 4e. Scars after healing wounds on the forearm and arm, in the patient shown on Figure 4b
Source: Own materials

ed it from closing too fast. A moist dressing was applied to the wound. One patient who suffered a bite on the index finger of her right hand developed phlegmon that reached up to the elbow (Fig. 3 a). Bacterial culture showed an infection with *Streptococcus pyogenes*. Despite an extensive incision and antibiotic therapy, a necrosis of the index finger occurred and the finger had to be amputated (Figs. 3 b, c). In another patient, with a primary bite wound on the palmar side of the wrist, severe phlegmon developed involving the metacarpus, forearm and upper arm. Wide incisions were made in all affected areas, which resulted in subsiding infection and a favourable course of treatment. In this patient, the culture also showed infection by *Streptococcus pyogenes*.

Further treatment was continued in the surgical department. Until the result of culturing was obtained, an empirical i.v. antibiotic therapy was continued. The dressings were changed every day, and half an hour of hand baths were also performed in a bowl with antiseptic liquid. Patients were encouraged to make movements with their fingers, possible in the full range of movements, even if there were open wounds on them (Fig. 3 c). On average 4 days after the incision, when the symptoms of infection subsided, a secondary wound suture was performed. Usually 1-3 stitches were placed on the hand, but on the forearm, where the incisions

Table 1. Classification of bite wounds severity

1°	Bruising of the skin by the animal's teeth Skin scratching Superficial, single skin wound A depression in the skin caused by a tooth (interruption of continuity) Tearing of the skin with exposure of part of the subcutaneous tissue
2°	Deep wound, reaching fascia and muscles
3°	Wound with soft tissue loss and necrosis

Source: Compiled by the authors of this study

Table 2. Demographic and clinical data of 15 patients with cat-bite wounds

Variable	Description
Sex	F-9, M-6
Age (mean, range)	43 years (27-64)
Left/Right hand	L - 9, R - 6
Site of bite	Digit - 7, dorsal metacarpal - 4, palmar metacarpal - 2, wrist - 2
Cat known/unknown	Known - 12, unknown - 3
Time from injury to presentation (mean, range)	14 hours (8-76)
Time of hospital stay (mean, range)	4.3 days (4-12)
Post-incision woung suture	All patients
Time form incision to wound suture (mean, range)	4 days (3-8)
Complications	6 patients

Source: Compiled by the authors of this study

Table 3. Types of bacteria grown from 12 wounds after cat-bites

Type of the organism	Number of patients
Pasteurella multocida	9
Streptococcus pyogenes	4
Staphylococcus aureus	3
Neisseria species	3
Bergeyella zoohelcum	2
Negative result	3

Source: Compiled by the authors of this study

were long, even a dozen or so were needed (Fig. 3 d; Figs. 4 a, b). Patients were discharged home at a mean of 4.3 days after admission (range 4-15), and further treatment was carried out in the outpatient clinic.

Rabies prevention. In the case of 3 stray cats, one was captured and handed over for veterinary observation. The bitten patient himself did it, and the result of the observation was negative. In the remaining 2 cases, patients were referred to an infectious diseases clinic after being discharged from the hospital, where they received rabies vaccination and immunoglobulin, according to the post-exposure schedule.

OUTPATIENT TREATMENT

The time of outpatient treatment was 2.3 months (range 1-8) on average. Only in 4 patients did the wounds heal within 2 weeks, without inflammatory reaction. In the remaining 11 patients, the affected finger or hand remained swollen for several weeks, and mobility was limited. Due to the prolonged inflammatory recation (without infection) of the healed wound, 5 patients received 10 days oral steroids course (20 mg of prednisone), which was effective and the symptoms of inflammation slowly resolved. The longest treatment lasted 8 months, in a 45-year-old patient, after her own cat bit the back of her left hand.

METHODS

All patients whose treatment was completed were called for a follow-up examination at a mean of 1.8 years from the injury and admission to the hospital (range 1-3 years). Thirteen patients were available, two could

Table 4. Results of treatment of 13 patients in the study

Variable	Value	
	Median	Range
Pain intensity (NRS)	0	0-3
Finger mobility	Full – 11 Incomplete -2	
Wrist mobility	Full – 12 Incomplete -1	
Grip strength	37 kG	15-54 kG
QuickDASH score (range 0-100)	6	1-28

Source: Compiled by the authors of this study

not be contacted. During the examination, they were asked about pain (in Numeric Rank Scale, NRS), the range of motion of the fingers and wrist was assessed (full- or limited mobility), grip strength was measured with the Jamar dynamometer and the dexterity of the hand was examined using the quickDASH (Disability of Arm, Shoulder and Hand) questionnaire [7].

RESULTS

Bacteriological cultures. The types of bacteria cultured from patients' wounds are summarized in Table 3. The most commonly isolated organism was *Pasteurella multocida*, typical of the normal oral flora of healthy cats. In 4 cases, *Streptococcus pyogenes* was identified and this organism was responsible for the most severe infections (phlegmons). *Staphylococcus aureus* organism was cultured in 3 wounds. In 10 patients, more than one bacterium (mixed flora) was cultured, and in four patients the culture result was negative.

Table 3.

Results of biochemical tests. Blood was taken in all patients to examine inflammation parameters: leukocyte count, CRP (C-reactive protein) and procalcitonin concentrations. The average number of leukocytes in the first blood sample was 9.4 G/L (range 5-24 G/L), CRP concentration was 16.7 mg/dL (range 2-166 mg/dL), and procalcitonin 0.8 ug/dL (range 0.2-12 ug/dL). In 11 patients (73%), inflammatory parameters were within normal limits, while in all 4 cases of streptococcal infection, they were significantly elevated.

The patients were assessed at a mean of 1.8 years after the injury (range 1-3 years). Thirteen patients, 8 women and 5 men, aged at a mean of 43 years were available. The results are summarised in Table 4. Most patients did not complain of pain at all (median NRS 0 points), only 3 reported slight pain in the hand (2-3 NRS points). None of them took painkillers. Four patients reported moderate pain in the hand when exposed to cold. Two patients had a slight deficit in finger flexion, and one had incomplete wrist mobility. All patients regained good grip strength, and the dexterity of the hands: the quickDASH scores were almost the same as in the healthy hand (median 6 points). The patient after the amputation of the index finger also regained good hand function: full flexion of the remaining fingers, grip strength of 83% of the strength of a healthy hand and satisfactory function (14 quickDASH points). Therefore, it can be said that the result of treatment in all patients was good and all of them regained the normal function of their injured hands. Figures 4 a-e illustrate a very good result of treatment of a patient 1.5 years after being bitten by a cat in the metacarpus, who developed streptococcal phlegm of the entire upper limb. The total treatment time was 2.3 months on average (median 1.9 months). One patient bitten by her own cat on the index finger of her left (non-dominant) hand was treated for 8 months due to prolonged swelling of the dorsal side of the hand and limited mobility of the fingers. This patient developed chronic aseptic inflammation of the skin and subcutaneous tissue, which resolved only after 8 months, after the previous two, 10-day prednisone courses. This patient had the worst outcome due to reduced finger mobility, poor strength (15 kG) and hand dexterity (quickDASH 28 points).

COMPLICATIONS

A case in which necrosis and amputation of the finger occurred can be considered a complication. Also, extended, several-week treatment of inflammation after the healing of surgical wounds in 5 patients who received steroid therapy can be considered a complication resulting from the bite.

DISCUSSION

The paper presents the results of treatment of 13 patients with cat-bites to the hand. All patients were treated surgically with incisions in the infected area and antibiotics. A positive cultures were found in 12 cases (80%), which is consistent with the results from other publications (57-86% positive cultures) [4, 5]. *Pasteurella multocida* was the dominant microbe, found

in 9 patients. The results of treatment evaluated almost 2 years after an accident were generally good, because all but one patient regained normal function of their injured hands. The therapeutic algorithm included early surgical intervention: a wide incision not only of the bite site, but of the entire area of visible infection, and empirical antibiotic therapy showed great effectiveness. The most severe infections were caused by *Streptococcus pyogenes* organism, which is not frequent component of normal oral flora of cats. Streptococcal infection spreads rapidly and can involve the entire upper limb (Fig. 3 a; Fig. 4 b). It is characterized by infiltration of the skin and subcutaneous tissue, which is soaked with turbid fluid, which, after the incision, can be squeezed out of the wound like water. Unlike in staphylococcal infection, pus collections are rarely seen. Streptococcal infections quickly cause a systemic inflammatory reaction, which in 4 patients from the study manifested by elevated inflammatory parameters. Eventually, none of them developed sepsis, which can be attributed to rapid surgical intervention and start with antibiotics.

The extent of the incisions in patients in this series is noteworthy: they involved the entire area of visible inflammation (redness of the skin). This is important, because small incisions do not prevent spreading the infection, which results in the need for next operation, usually the subsequent day. Such situations occurred in 3 of our patients. Extensive incisions of the skin and subcutaneous tissue on the forearm, up to 15 cm length, made on the palmar and dorsal sides allow evacuation of infected fluid and limit infection. This is clearly seen when changing the dressing the next day after the procedure, when the originally tight and reddened skin turns pink and begins to wrinkle. After a well-made incision, the improvement occurs almost in the eyes. In all cases of phlegmon after a cat-bites the depth of the incision was limited to the skin and subcutaneous tissue, since the infection did not extend beyond the fascia. Only in 2 cases pus collections were found on the finger and metacarpus (Fig. 2 a). Both patients presented to the hospital more than 2 days after the bite and both were infected with *Pasteurella multocida* and *Staphylococcus aureus* organisms. Deep infection, involving the tendon sheath, joints or bones was seen in none of the patients in this series. A quick and wide incision in the infected area appears to prevent deeper penetration of the bacteria, although with finger wounds, the animal's thin teeth may have reached all the way to tendons and bones. The purulent tendovaginitis, osteomyelitis and joint infections (septic arthritis) are reported in the literature as a complication of cat bites [8, 9]. The relatively quick closure of extensive incisions is an interesting part of our treatment. Wounds were sutured immediately after the signs of inflammation (redness and swelling) had subsided, and there was no wound exudate. Usually the wound was suitable for suturing after 4 days from the original incision. Skin closure was performed in the procedure room of the surgical ward under WALANT anaesthesia. Figures 4 c-e show very good cosmetic result of the treatment, despite such extensive incisions.

In 3 cases of bite wounds, negative cultures were obtained. There are various possible explanations of this. The first is that bite wounds are not always infected, although they are primary contaminated. Signs of infection can develop within a few hours of the bite, but at the time of sampling during surgery, the bacterial multiplication may be not enough to grow on the slide. In addition, the patient's own immune mechanisms and administration of an antibiotic could have already effectively eradicated the bacteria [4]. Another reason may be the difficulty of cultivating *Pasteurella* species: if their number in the sample is too small, the growth in culture may not occur [3, 4, 9].

Another noteworthy observation from this study is the long-term resolution of inflammation in 5 patients, after the wounds have healed. The author noted this phenomenon in several other patients treated conservatively for cat bites, not included in this work. This can be explained by chronic, aseptic inflammation after infection with *Pasteurella multocida*, which smoulders in the subcutaneous tissue, despite the absence of the bacteria themselves. This was observed only in cases where *Pasteurella* species were grown from the wounds, and, for example, wounds after incisions of purulent streptococcus infections healed without reactions. However, this is only a speculation, not supported by evidence. In such cases, a 10-day course of 20 mg/day prednisone was highly effective. In one study the authors used topical steroids for chronic wounds displaying abnormal inflammation [10].

No other similar observations have been found in the literature.

There are single articles in the literature presenting results of the treatment of cat-bite. Below is a summary of a few of them.

Babović et al. (2014) presented the results of treatment of hand cat-bites in 193 patients, over a period of 3 years. Fifty-seven patients (30%) required hospital treatment, which consisted of i.v. antibiotics administration, and in 38 patients (67%) incision of the bite site and wound rinsing. Eight patients (14%) required more than one operation due to local complications. Risk factors for complications were: smoking, immunity defects and the bite over the joint or tendon sheath. However, the time from the bite to the start of treatment

had no effect on the risk of complications and the final outcome of treatment [11].

Kheiran et al. (2019) presented the results of treatment of 20 patients, 18 women and 2 men, aged at a mean of 58 years, after being bitten by cats on their hands. The most common bite site was the index finger in 9 cases. Eleven patients presented to the hospital within 2 days after the bite, and 9 patients after 2 days. All patients underwent surgery by incisions at the sites of infection and received i.v. antibiotics. Seven patients (78%) required repeated operations due to complications: tendon, bone and ligaments involvement, or necrotizing fasciitis. The most common organism isolated from wounds was *Pasteurella multocida.* The mean stay in the hospital was 3.4 days for patients who presented earlier and 9.2 days for those who presented after 2 days ($p < 0.01$). Four patients required amputation of their fingers due to necrosis. The authors conclude that delayed treatment of cat-bite wounds, diabetes and immunocompromised conditions increase the risk of eventful course of infection, the need for multiple surgeries and amputation of fingers. They recommend immediate and wide incision of wounds that show signs of infection [8].

Ng et al. (2025) presented epidemiological data and treatment results of 168 bite wounds to the extremities, registered over a period of 10 years. Hand dog-bites (110 patients, 65%) and hand cat-bites (56 patients, 33%) were predominant. Eighty-eight patients (52%) presented within the first day after the bite, and the rest within 2-6 days. Dog bites were the cause of 38 multi-tissue injuries (tendon, nerve damage, and bone fracture), while cat bites were the cause of infections only. The most common bacterium grown from infected cat wounds was *Pasteurella multocida*. Forty-three of the 56 patients (77%) bitten by cats required hospitalization, and their treatment consisted of incisions, rinses, and i.v. antibiotics. In 7 patients, complications occurred in the form of prolonged healing of wounds and tendinous felons. Necrosis of the finger occurred in one patient, requiring amputation [12].

Some papers suggest the possibility of primary suturing of bite wounds, after thorough rinsing and removal of devitalized tissues. This was especially true for facial bite wounds caused by dog and was motivated by cosmetic reasons [13, 14]. However, wounds inflicted by cats are not suitable for such treatment and, on the contrary, usually require a wide incision.

CONCLUSIONS

The results of our study show that cat-bite wounds be the reason for extensive infections and serious complications. A cat bite causes bacteria on their thin teeth and in their saliva to be introduced relatively deep into the subcutaneous tissue, where they have good conditions for multiplying. Therefore, such wounds that show symptoms of infection require a wide incision, rinsing, admission to the hospital and i.v. antibiotics. Such an intervention prevents the spread of infection, the development of phlegmon and shortens the treatment time. The most dangerous are wounds infected with *Streptococcus pyogenes*, which causes diffuse phlegmons that affect the entire limb. In some cases, a cat bite may cause finger necrosis or prolonged aseptic inflammation that requires treatment with steroids.

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CONFLICT OF INTEREST

The Author declare no conflict of interest

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