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Conservative treatment for pyogenic flexor tenosynovitis: a single institution experience

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ABSTRACT

Pyogenic flexor tenosynovitis (PFT) of the hand is a common infection which is clinically diagnosed using Kanavel's signs. Delay in diagnosis and treatment may lead to devastating outcomes, including reduced range of motion (ROM), deformities, tendon impairment or even amputation. While the gold standard for treatment is irrigation and debridement of the flexor sheath, little is known about the outcomes of conservative treatment with intravenous (IV) antibiotics. Patients treated conservatively for PFT between 2000 and 2013 were included. Demographic information, co-morbidities and clinical features at presentation such as Kanavel's signs and inflammatory markers levels were gathered. Treatment course, length of stay (LOS), functional outcomes and complications were collected. Fifty-four (54) patients presented with PFT in the study period. Forty-six (46) patients, ages 19–84 years old, who were treated conservatively were included. Average time from symptoms onset to presentation was 4.6 ± 7.1 days. Fourteen (14) patients failed to improve with course of oral antibiotics prior to presentation. The average number of Kanavel's signs was 3 ± 0.7 . Inflammatory markers were elevated in 82.2% of patients. The mean LOS was 4.7 ± 2 days. Forty-four (44) patients continued follow-up for 55 ± 45 months. Final flexion ROM was full or minimally limited in 69% of patients. Three patients were eventually operated. Complication rate for the entire cohort was 4.3% and no fingers were lost. This retrospective case series indicate that inpatient empirical IV antibiotic therapy can be considered for patients presenting with uncomplicated PFT, provided it is practiced under a hand specialist's surveillance.

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Introduction

Pyogenic flexor tenosynovitis (PFT) is a common and severe hand infection which can have devastating effects if treated improperly [1,2].

Patients with PFT who present early, within 24–48 h from symptom onset, can be treated by splinting and IV antibiotics [3]. For all other patients the literature uniformly stresses the importance of early operative intervention. These recommendations, however, are based either on early expert opinion articles, some of them published before the introduction of the modern antibiotic treatment [4] or on basic science reports of increased intracompartmental pressures in infectious tenosynovitis that impairs nutrients delivery to the tendon sheath [5].

Currently, there are no clear-cut criteria to define neither the time limit within which is safe to delay an operative procedure nor criteria to define success or failure of the intravenous antibiotic treatment. While the operative treatment may be safer, it is not devoid of complications [6–8], and in some tenosynovitis cases, it may be unnecessary.

For the last 15 years, we have been treating patients diagnosed with PFT who were presented without sepsis and without an abscess, with intravenous antibiotics only, regardless the time from the beginning of the symptoms, the ethology or the preadmission oral antibiotic treatment. Only those patients who, under

our supervision, had worsening of their condition, were offered an operative treatment. The aim of this study was to present our experience with conservative treatment for PFT of the hand.

Materials and methods

The study protocol was approved by the local Institutional Review Board, approval number 0100-13-RMC. The electronic medical records (EMR) of the department of orthopaedic surgery of a tertiary medical centre were searched for all patients diagnosed with infectious flexor tendon tenosynovitis from 2000 through 2013. Informed consent was waived by the IRB due to the retrospective nature of the data collection.

The study inclusion criteria were age above 18, a diagnosis of flexor tendon tenosynovitis made by a hand surgeon based on the presence of one or more Kanavel signs, admission to the orthopaedic department for treatment under intense supervision (including a daily examination by a hand surgeon) and non-operative treatment with intravenous antibiotics for more than 48 h.

Exclusion criteria were: patients who were presented with an abscess, with skin ulceration and pus draining from the wound, with skin necrosis or other signs of vascular compromise, with signs of proximal spreading of the infection such extensive

cellulitis and patients in whom the hand surgeon worried of impeding sepsis were considered to have a severe infection, were operated within 24–48 h from admission were excluded from the study. In addition, patients with inflammatory or rheumatoid conditions that could mimic pyogenic tenosynovitis were also excluded.

Both the charts and the in hospital EMR were reviewed. For most patients, depending on the patient’s insuring health medical organization, the pre-admission and post-admission community orthopaedic consult notes were available for review through a link to the community EMR.

Demographic parameters, the presence of comorbidities, any history of trauma, the pre-admission antibiotic treatment and the findings on physical examination at admission were collected from the individual medical charts. WBC levels higher than 10.8, and CRP of over 0.5 mg/dL were considered elevated. The primary treatment either intravenous antibiotic or combined intravenous antibiotic and delayed surgical treatment performed later than 48 h from admission was noted. The range of motion was noted at final follow-up. In our hospital, the finger range of motion is typically noted using the Linear Measurement System [9] and the thumb IP range of motion is typically measured in degrees. The measurements were converted to a scale of motion deficit as presented in Table 1. Intra-operative findings were recorded, and the presence of complications was documented. All patients were invited for a post-discharge exam at the hospitals hand clinic. If no further treatment was required, they were instructed to continue community care.

As diabetes mellitus (DM) is considered to be a risk factor for worse outcomes following PFT [8,10], following data collection, an analysis was made to compare the outcomes of these patients with those who were normoglycaemic.

Continuous variables are presented with mean and standard deviation (SD). Quantitative variables are presented with absolute and relative frequencies. Fisher’s exact test was used for comparison of proportions. Student’s *t*-test was used to compare means of numeric variables between groups, following the Shapiro–Wilk test for the verification of normal distribution of the data. All reported *p* values are two tailed. Statistical significance was set at *p* < .05.

Results

Fifty-four patients, 35 males and 11 females, were diagnosed with PFT and admitted in the study period. Eight patients with a severe disease at presentation (of whom one with skin necrosis, three with purulent discharge from the wound, two with severe cellulitis) were treated surgically within 48 h based on the consulting hand surgeons’ decision and were excluded from the study.

Table 1. Fingers range of motion.

Fingers			
Flexion deficit (cm)		Extension deficit (cm)	
No	Deep palmar crest	No	Full extension
Mild	0–2	Mild	0–2
Moderate	2–4	Moderate	2–4
Severe	>4	Severe	>4
Thumb			
Flexion deficit (degrees)		Extension deficit (degrees)	
No	80	No	0
Mild	40–80	Mild	0–20
Moderate	20–40	Moderate	20–40
Severe	20–0	Severe	40–80

Forty-six patients were included in the study. Table 2 presents the demographic characteristic, clinical examination and laboratory values at presentation. The most common aetiology for PFT was laceration followed by patients who did not recall any insult. Average time from presentation to symptom onset was 4.6 (7.1) days, median 3 days (range: 0–45 days). Fourteen patients started oral antibiotic treatment prior to presentation at the hospital. Tenderness on palpitation of flexor sheet was the most prevalent Kanavel sign at presentation, followed closely by fusiform swelling. Thirty-seven patients were presented with elevated inflammatory markers (either leukocytosis, or elevated CRP or both).

Patients were admitted to the orthopaedic department and subsequently treated with empiric IV antibiotics for a duration of 2–12 days (4.7, SD 2.0) (Table 3). Cefazolin was chosen for the initial treatment in 27 (60%) patients and amoxicillin/clavulanate in 6 (13%).

Neither deep tissue culture nor blood cultures were taken, as patients were treated conservatively, and all but one were afebrile at presentation.

Forty-five patients have continued oral treatment following discharge, the majority of whom, thirty-three patients, with a first-generation cephalosporin (cefalexin). Overall length of antibiotic treatment (both IV and oral following discharge) was 4–19 days (11.3, SD 3.3).

Most patients (30), continued follow-up in the hospital clinic for an average period of 30 days. Thirty-nine patients continued community care for an average duration of 61.9 (SD 43.0) months (range: 0.9–160). Two patients were lost to follow-up. Functional outcomes at last follow-up available (the latest physical exam, regardless if performed within hospital or in a community clinic) are described in Table 3. Three patients were eventually treated surgically, as they did not improve following antibiotic treatment.

Table 2. Patients characteristics at presentation.

Age, average (SD)	47.8 (16.0)
Gender, n (%)	
Male	35 (76.1)
Female	11 (23.9)
Co-morbidities, n (%)	
Diabetes mellitus	8 (17.4)
Hypertension	9 (19.6)
Ischemic heart disease	3 (6.5)
Etiology, n (%)	
Laceration	24 (52.2)
Animal bite	3 (6.5)
Scratch	2 (4.3)
Contusion	1 (2.2)
No preceding trauma	16 (34.8)
Involved finger, n (%)	
Thumb	7 (15.2)
Index	12 (26.1)
Third	12 (26.1)
Ring	8 (17.4)
Small	5 (15.2)
Time from symptoms onset to presentation (days), average (SD) ^a	4.6 (7.1)
Pre-admission antibiotics, n (%)	14 (34.0)
Kanavel sings per patient, average (SD)	3.0 (0.7)
Kanavel sings, n (%)	
Tenderness on palpitation	45 (97.8)
Fusiform swelling	44 (95.7)
Pain on passive extension	37 (80.4)
Flexed resting position	12 (26.1)
Cellulitis, n (%)	8 (17.4)
Inflammatory markers, average (SD)	
Leukocytes ^b	10.0 (2.8)
CRP ^c	1.9 (2.1)

^aData not available for two patients.

^bData not available for one patient.

^cData not available for 11 patients.

Two patients improved and healed after surgery. In one patient, the infection had spread causing destruction of the pulley system and osteomyelitis (Table 4). An additional patient had a trigger finger which resolved without surgical intervention.

Eight patients were diagnosed with diabetes mellitus. They were older than the non-diabetic patients (63.4, SD 13.3 vs. 44.6, SD 15.2, $p = .005$). Diabetic patients were less aware of a preceding trauma and most of them reported the FTS to appear abruptly, while most of the non-diabetic patients recalled an antecedent trauma, mainly laceration ($p = .015$). A similar proportion of the diabetic patients were treated with antibiotics prior to admission, and the time from symptoms onset to presentation was also comparable. None of the diabetic patients required surgery, and they did not develop an increased rate of complication or worst clinical outcomes (Table 5).

The patients who were initially allocated for the surgical treatment group and therefore excluded from the study were 42.2 (SD 18) years old, four were male and four were female. None had diabetes mellitus. Six of the patients who were initially allocated

for surgery (75%) presented following laceration, one patient presented following an animal bite and one patient presented without prior injury. Time from injury to presentation was 5 (SD 3.5) days. Five patients (62.5%) failed oral antibiotic treatment either with Cefalexin or with Amoxicillin/Clavulanic acid prior to presentation. They have presented with an average of 3.3 (SD 0.8) Kanavel signs. Three of whom had pus drainage at presentation and an additional patient presented with extensive skin necrosis. Three had leucocytosis. CRP was available for four of the eight and elevated in three of them. Two surgical wound cultures were positive for Methicillin sensitive staphylococci (25%), one for *Pasteurella multocida* (12.5%), one for *Streptococcus pyogenes* (12.5%) and one for *Pseudomonas aeruginosa* (12.5%). Three tissue cultures (37.5%) were negative. During surgery, a destruction of the pulley system was noted in two of these patients. These patients were hospitalized for an average of 10.7 (SD 9.4) days. Six patients (75%) continued follow-up of an average of 3.4 (SD 2.8) years. At the end of follow-up, a severe limitation in flexion ROM was noted in one patient, a moderate limitation in three, a mild limitation in one and no limitation in a single patient. Severe extension limitation was noted in one patient, a moderate limitation in two, a mild limitation in one and a normal ROM in two patients. No fingers were lost.

Table 3. Results.

Follow-up (months), average (SD) ^a	55.0 (44.9)
Hospital's clinic follow-up (days), average (SD) ^b	30.4 (35.5)
Community follow-up (months), average (SD) ^c	61.9 (43.0)
Number of antibiotics per patient, n (%) ^d	
One	22 (48.9)
Two	22 (48.9)
Three	1 (2.2)
Duration of antibiotic therapy during hospitalization (days), average (SD)	4.7 (2.0)
Duration of antibiotic therapy at discharge (days), average (SD)	6.7 (2.6)
Flexion range of motion, n (%) ^e	
No limitation	23 (54.8)
Mild	6 (14.3)
Moderate	11 (25.0)
Severe	2 (4.8)
Extension range of motion, n (%) ^f	
No limitation	34 (79.1)
Mild	0 (0.0)
Moderate	9 (20.9)
Severe	0 (0.0)
Complications, n (%)	
Required surgery	3 (6.5)
Amputation	0 (0.0)
Tendon rupture	0 (0.0)
Destruction of sheath or pulley system	1 (2.2)
spread of infection	2 (4.3)
Osteomyelitis	1 (2.2)
Loss of skin	0 (0.0)

^aData not available for two patients.

^bData not available for 16 patients.

^cData not available for seven patients.

^dData not available for one patient.

^eData not available for four patients.

^fData not available for three patients.

Discussion

PFT is a common hand infection most often treated with surgical debridement. We present a case series of 46 patients treated conservatively. The diagnosis of PFT was based on clinical evaluation performed by a fellowship trained specialist and supported by laboratory results (CRP, WBC) [11]. Additional eight patients were excluded from the study since they presented with a severe condition, either an abscess or skin necrosis or with severe cellulitis and were recommended surgical treatment on arrival. To our knowledge, this study is one of very few studies describing results of non-surgical treatment for PFT.

Although most patients presented more than 48 h from symptoms onset, complication rate was low, and only three of our patients eventually underwent surgical debridement. Unlike other series describing the treatment of PFT, we had no patients in whom ischemia developed as a sequela of PFT, and none of the patients required an amputation [10,12,13]. Neither of our three operated patients required further surgery [12–14]. When surgery was performed, in two of the three patients, results were fairly satisfactory, as only a mild limitation in flexion ROM was noted at final follow-up. For the third patient, complications were controlled with surgery and the digit was preserved (Table 4). Finally, length of stay was relatively short, 4.7 (SD 2) days, shorter than others, advocating surgical treatment [12–14].

Table 4. Patients who required surgery^a.

Nos.	Age	Time from symptoms onset to presentation (days)	No. of Kanavel signs	Elevated inflammatory markers	Time from presentation to surgery (days)	Final flexion range of motion	Duration of antibiotics before the surgery (days)	Final extension range of motion	Complications
1	59	7	2	WBC, CRP	10	Severe limitation	1	Normal	Spread of infection, destruction of pulley sheet and osteomyelitis
2	71	5	3	None	5	Mild	6	NA	None
3	24	10	3	WBC	6	Mild	5	Mild	None

^aAll patients were male, none had diabetes mellitus, and for all of them the aetiology for infection was laceration.

Table 5. A comparison of diabetic and non-diabetic patients treated conservatively for pyogenic flexor tenosynovitis.

	Diabetic (N = 8)	Non-diabetic (N = 38)	p Value
Age, average (SD)	63.4 (13.3)	44.6 (15.2)	.005
Gender, n (%)			
Male	6 (75)	29 (76.3)	1
Female	2 (25)	9 (23.7)	
Aetiology, n (%)			
Preceding trauma	2 (25)	28 (73.7)	.015
No preceding trauma	6 (75)	10 (26.3)	
Time from symptoms onset to presentation (days), average (SD) ^a	3.7 (3.2)	4.8 (7.5)	.538
Pre-admission antibiotics, n (%)	3 (37.5)	11 (28.9)	.684
Laboratory data, n (%)			
Elevated WBC ^b	1 (12.5)	9 (24.3)	.661
Elevated CRP ^c	6 (85.7)	18 (75)	1
Hospital's clinic follow-up (days), average (SD) ^d	28.4 (29.4)	30.8 (37.1)	.880
Community follow-up (months), average (SD) ^e	31 (23.8)	68.6 (43.6)	.006
Flexion range of motion, n (%) ^f			
No limitation	3 (37.5)	20 (58.8)	.387
Mild	1 (12.5)	5 (14.7)	
Moderate	4 (50)	7 (20.6)	
Severe	0	2 (5.9)	
Extension range of motion, n (%) ^g			
No limitation	5 (62.5)	29 (82.9)	.332
Mild	0	0	
Moderate	3 (37.5)	6 (17.1)	
Severe	0	0	
Complications, n (%)			
Required surgery	0	3 (7.9)	1
Amputation	0	0	1
Tendon rupture	0	0	1
Destruction of sheath or pulley system	0	1 (8.6)	1
spread of infection	1	1	.321
Osteomyelitis	0	1 (8.6)	1
Loss of skin	0	0	

^aData not available for one patient from each group.

^bData not available for one patient from the diabetic group.

^cData not available for one patient from the diabetic group and for 10 patients from the other group.

^dData not available for three patients from the diabetic group and for 13 patients from the other group.

^eData not available for one patient from the diabetic group and for six patients from the other group.

^fData not available for four patients from the non-diabetic group.

^gData not available for three patients from the non-diabetic group.

The leading cause for infection, responsible for more than half of the cases, was laceration, as described by others [1,2]. In line with previous studies, many of our patients had no recollection of any antecedent insult [15,16], and this was even more pronounced for diabetic patients, as perhaps their immunocompromised state puts them in an increased risk for infection, even from a minor, unnoticeable insult [17]. For patients who stated a bite as the cause of trauma, amoxicillin/clavulanate was usually initiated for an anaerobic coverage. Given the low incidence of community acquired MRSA in our country [18,19] we consider cefazolin to be an appropriate initial treatment. We believe that the choice of antibiotic should be made locally based on emerging patterns of resistance, and after consulting an infectious disease specialist or in concordance with the Infectious Diseases Society of America Guidelines [20].

The patients were discharged when the local signs of infection subsided and they were able to actively flex and extend their fingers without pain. The patients continued oral antibiotic treatment for an additional 5–7 days until the planned clinic follow up. In patients in whom the resolution of symptoms was incomplete the antibiotic treatment was prolonged. Given the low incidence of recurrent infection, this treatment protocol seems to be appropriate.

There literature regarding the outcomes of conservative antibiotic treatment for PFT is scarce. Still, our results are in line with those of another smaller cohort describing antibiotic treatment

for flexor tenosynovitis. Di Pasquale et al. [16] presented a cohort of a dozen patients with early infectious flexor synovitis who received antibiotics without surgical drainage with 75% of good clinical outcomes. Murray [21] has also described good clinical outcomes of two patients treated with antibiotics for PFT following early presentation. While a recent survey among physicians discovered that almost 50% would proceed to surgical decompression and washout of PFT even in patients diagnosed early, with 88% advocating surgery when treating a patient whose diagnosis was delayed [22], perhaps as data regarding satisfactory clinical outcomes of conservative treatment for PFT will gather, more surgeons will choose this treatment.

We acknowledge several limitations of this study. Firstly is the retrospective nature of data collection. Secondly, there is no control group since the vast majority of our patients were treated non-surgically and the proportion of patients who underwent surgical treatment was too small for comparison. Thirdly, as treatment was medical, we do not possess tissue cultures to confirm the diagnosis. However, we excluded from this cohort all the patients who had an inflammatory condition at presentation. Lastly, since we had access to the community EMR, our prolonged (69 months) post-discharge follow-up enabled us to exclude any patient that developed an inflammatory disease over the years. Finally, we are aware of the increased role of ultrasound examinations in management of FTS [23,24]; however, some of our patients were admitted as early as 2003 when the use of ultrasound for the diagnosis of PFT was

less common. Moreover, we consider ultrasound to be of assistance in the management of the condition but not crucial neither for diagnosis nor for treatment of the condition.

Conclusion

Our results suggest that conservative treatment with empirical IV antibiotics in patients, presenting without sepsis or abscess and followed cautiously with repeated clinical assessments in an inpatient setting is safe and should be considered as an alternative to surgical debridement. Further larger scale prospective studies are needed.

Disclosure statement

No potential conflict of interest was reported by the authors.

Ethical approval

The study protocol was approved by the Rabin Medical Center Institutional Review Board, approval number 0100-13-RMC. Informed consent was waived by the IRB.

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