Infection (2019) 47:225–231
https://doi.org/10.1007/s15010-018-1236-z

ORIGINAL PAPER

Current opinions regarding the management of pyogenic flexor tenosynovitis: a survey of Pulvertaft Hand Trauma Symposium attendees

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Received: 10 July 2018 / Accepted: 10 October 2018 / Published online: 1 November 2018

Abstract

Purpose Pyogenic flexor tenosynovitis (PFT) is recognized as a severe infection of the hand with potentially disastrous outcomes. The mainstay of treatment has been emergent surgical washout. Recent evidence suggests potential for conservative management with a combination of intravenous antibiotics, elevation and splinting. We aim to determine current management of PFT to guide further education and research.

Method An electronic survey was distributed to attendees at the Pulvertaft Hand Trauma Symposium in May 2017. The survey was also sent to previous attendees. The survey was compiled by hand surgeons and piloted within a tertiary centre prior to dissemination. Questions focused on three clinical vignettes describing PFT of increasing severity. Responses were analyzed using Surveymonkey.

Results A total of 91 clinicians responded. Almost 50% would proceed to surgical decompression and washout even in patients diagnosed early. This increased to 88% when treating a patient whose diagnosis was delayed. The majority of those advising surgery felt this should be within 24 h. More than 50% advocate active mobilization either immediately or as soon as possible regardless of severity. Almost all would use either general or regional anaesthesia and a two-incision technique with catheter irrigation.

Conclusions Our survey demonstrates large variation in the management of PFT. Advice from the pre-antibiotic era continues to be followed with some clinicians continuing to advocate open surgery. There is substantial discrepancy regarding duration of immobilization. Further investigation into the management and outcomes of PFT is required to establish best practice guidelines for this rare but potentially devastating condition.

Keywords Infection · Flexor tendon sheath · Pyogenic flexor tenosynovitis

This is a cross-sectional analysis of the current management of PFT amongst attendees at the Pulvertaft Hand Trauma Symposium. It is clinically relevant as it identifies huge variation in management and a need for further research into the best possible treatment for this potentially devastating condition.

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s15010-018-1236-z) contains supplementary material, which is available to authorized users.

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Introduction

Pyogenic flexor tenosynovitis (PFT) has long been recognized as a potentially severe infection of the hand which can have disastrous outcomes if inadequately treated. The presence of a collection of purulent fluid within the closed space of the flexor sheath, combined with bacterial proliferation, increases the volume and pressure within the sheath, potentially obstructing the blood supply. This increase in pressure, combined with the release of toxins and proteolytic enzymes from the bacteria, can result in tendon necrosis. The risk of tendon necrosis, subsequent rupture and spreading infection was the basis of Kanavel's opinion in 1912 [1] that when the diagnosis was clear "operation should be most prompt". This opinion was perpetuated by Grinnell [2] and, more recently by Burke [3]. It is important to note that this aggressive

surgical approach was first described before antibiotics were widely available and non-operative measures consisted of a "moist, hot dressing" and immobilization [1]. Delay in surgical debridement was associated with an increased risk of both amputation and death.

The availability of antibiotics has changed the management of other conditions traditionally treated with urgent surgery such as early appendicitis [4] and epidural abscesses [5]. There is currently no level 1–3 evidence for the management of PFT and the most cited papers are from either before the discovery of antibiotics or the sulfonamide era. The expert evidence in the books and papers cited is simply reiterated from that era. The evidence for antibiotic therapy alone in the management of PFT is small and limited (Seiler [6], Stevanovic and Sharpe [7], McDonald [8], DiPasquale [9]) but is sufficient to suggest that surgery is not the only possibility and that high-quality surgical trials of surgery versus antibiotics would be of benefit. We aim to assess current opinions regarding the management of PFT to guide further education and research into this potentially devastating condition.

Methods

An electronic survey was created and distributed to current and past attendees at the Pulvertaft Hand Trauma Symposium in May 2017 following a local pilot study. Along with obtaining basic data regarding subspecialty and seniority, participants were requested to select their preferred treatment options in response to three short vignettes. The results were processed using survey monkey's online analysis tools.

The vignettes describe three different patients with a diagnosis of pyogenic flexor tenosynovitis. They are otherwise healthy adults; the primary concern is the initial management of these patients on presentation to the hand surgery team. The first describes a very early diagnosis with no history of trauma. The second describes a fairly early diagnosis with a history of penetrating trauma. The third describes a delayed presentation in a patient who has failed to improve with oral antibiotics in the community.

1. Within a few hours an otherwise healthy adult patient is referred from the Emergency Department with a few hours history of a painful non-dominant middle finger. It has mild redness and swelling. It is tender to touch along its flexor aspect and the patient dislikes passive extension. The patient denies any trauma. The clinical diagnosis is acute flexor sheath infection. In addition to hand elevation and pain relief, what would be your first-line treatment for this patient?
2. At 24 h an otherwise healthy patient is referred from the Emergency Department following a penetrating injury from a piece of steel swarf (metal debris) to the non-dominant middle finger flexor aspect. The swarf was removed. At 24 h, the finger is red, warm, and painful. It is tender on the flexor aspect and the patient dislikes passive extension. The clinical diagnosis is flexor sheath infection. What would be your first-line treatment for this patient?
3. Over 48 h an otherwise healthy patient is referred from the General Practitioner with a 3-day history of penetrating injury (not bite) to the non-dominant middle finger flexor aspect. The patient has been treated with oral antibiotics but the finger is red, warm, swollen and tender. He is unable to extend the finger due to pain. The clinical diagnosis is flexor sheath infection. There is no foreign body in the finger. What would be your first-line treatment for this patient?

The participants were then asked to answer the following questions regarding their management for these patients and select the best possible answer from the options given.

1. What would your first-line treatment be for this patient?
2. How soon would you take this particular patient to the operating room (as per NCEPOD classification of intervention—see Online Appendix 1)?
3. Before starting treatment would you perform diagnostic needle aspiration of the flexor sheath?
4. At what stage would you encourage active movement of the finger?

Further questions were asked regarding the management of pyogenic flexor tenosynovitis in general including preferred methods of anaesthesia, preferred method of drainage, use of prolonged irrigation on the ward and repeated washouts in the operating room.

Results

We received a total of 91 responses.

The preferred management for each of the scenarios is summarized in Fig. 1 (initial management, Fig. 1a; recommended time to theatre, Fig. 1b; perform diagnostic aspiration, Fig. 1c; commence active mobilization, Fig. 1d). Figure 2 represents the preferred method of anaesthesia for patients undergoing surgical decompression and washout. Figure 3 represents the preferred method of drainage for tendon sheath infections. Figure 4 refers to the timing of further surgical washout. Figure 5 represents the outcomes expected in patients following treatment.

5% of respondents would leave an irrigation catheter in situ for intermittent drainage on the ward.

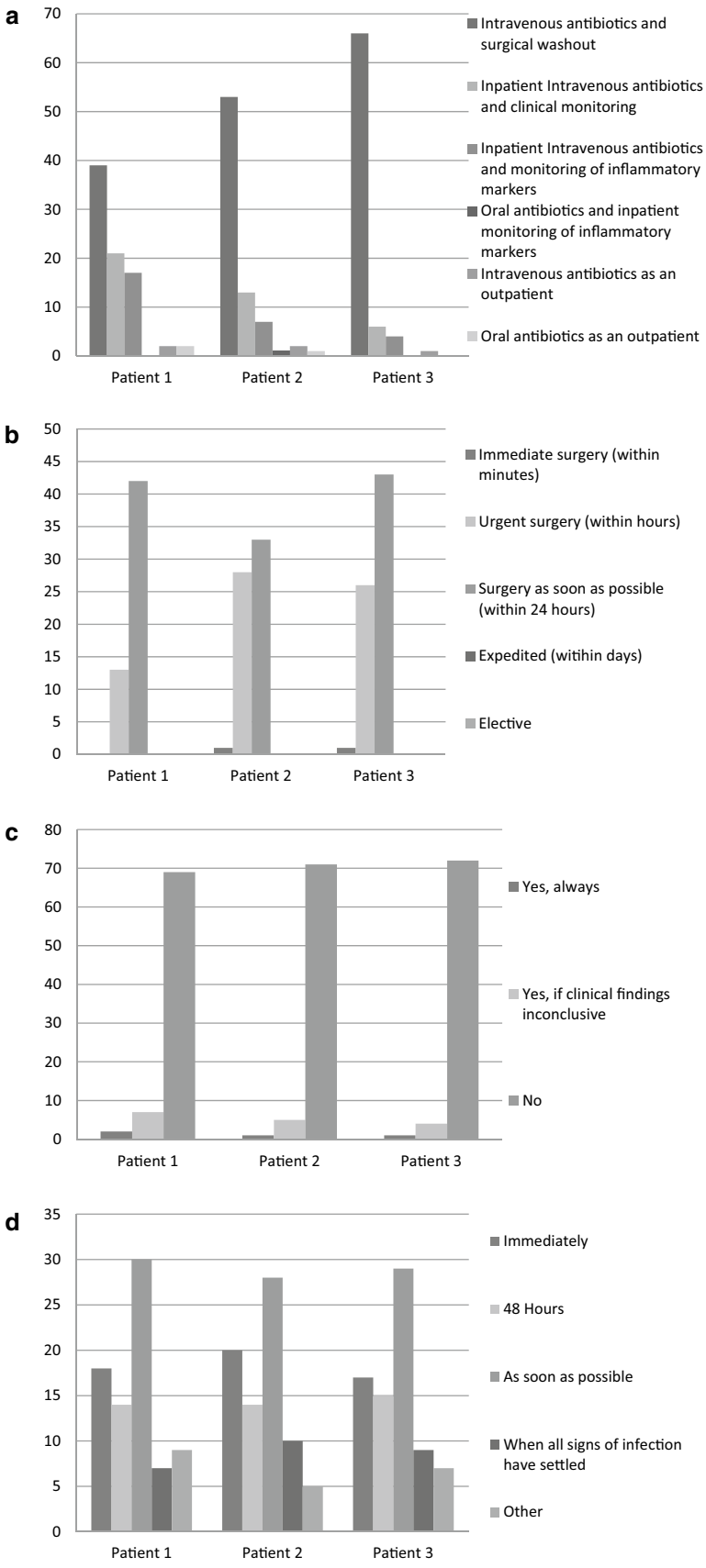


Fig. 1 **a** Initial management. Many clinicians would advocate a combination of IV antibiotics and surgical washout for all patients, increasing with the severity of the condition at the time of diagnosis. **b** Those that advocated surgical intervention advised this be within 24 h. **c** Very few respondents would perform diagnostic aspiration of the flexor sheath. **d** There was considerable variation in the period of immobilization irrespective of surgical or non-surgical management

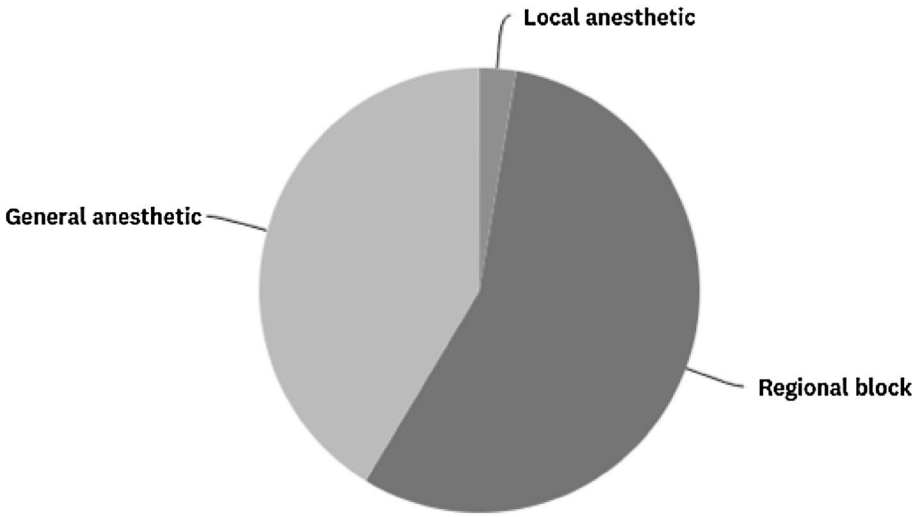


Fig. 2 56% of respondents would prefer to use a regional block. 41% would prefer to use a general anaesthetic. 3% of respondents would prefer to perform decompression and washout under local anesthetic

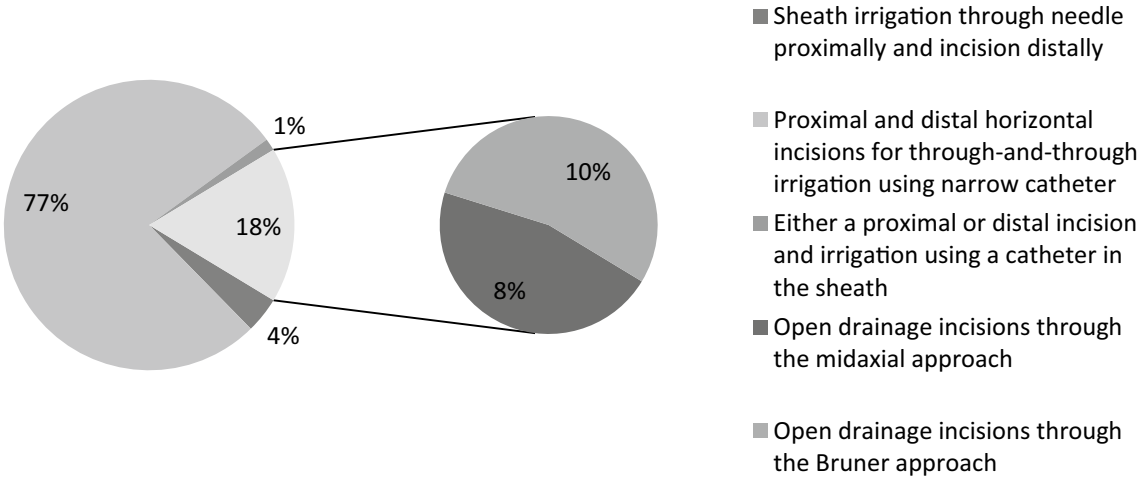
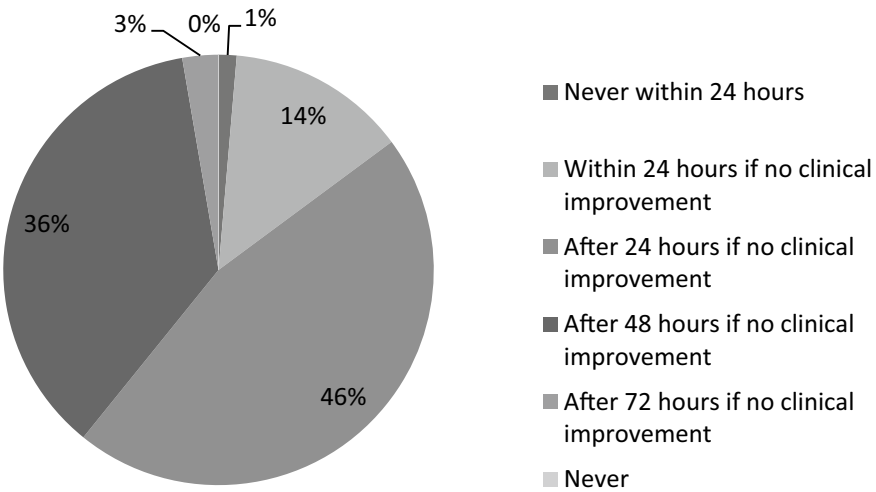


Fig. 3 The majority of respondents would utilize a minimally invasive catheter irrigation technique for surgical drainage. However, 18% would choose an open technique

Fig. 4 14% would take the patient back to surgery within 24 h if there was no evidence of clinical improvement. 46% would take the patient back to surgery if there was no evidence of improvement after 24 h. 36% would wait until 48 h before returning to surgery and 3% would wait until 72 h



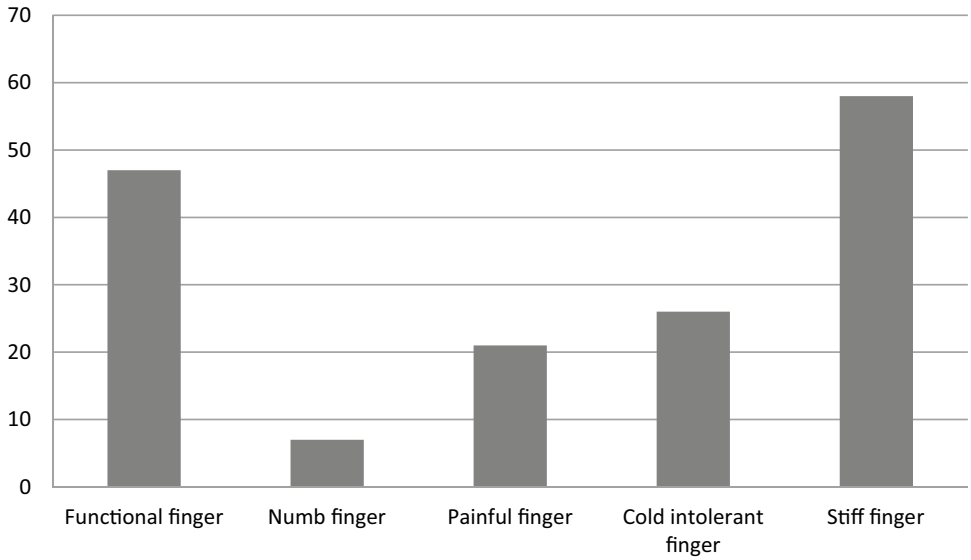


Fig. 5 63% of respondents believe patients are often left with a functional finger after surgical management of pyogenic tenosynovitis. 77% believe patients will have a stiff finger. 35% feel the patient is likely to experience cold intolerance and 28% believe they will have persistent pain. 9% of respondents believe patients will frequently have numbness

Table 1 Michon classification [12]

Intraoperative stage	Characteristic findings	Treatment recommendation
Stage I	Increased fluid in the sheath, primarily serous exudate	Minimal invasive drainage and catheter irrigation
Stage II	Cloudy/purulent fluid, granulomatous synovium	Minimal invasive drainage ± indwelling catheter irrigation
Stage III	Septic necrosis of tendon, pulleys, or tendon sheath	Extensile open debridement; possible amputation

Discussion

Our results demonstrate a huge variation amongst clinicians in the current management of pyogenic flexor tenosynovitis (PFT). Advice from the pre-antibiotic era of emergent surgical debridement continues to be followed by many and a proportion of surgeons continue to use an open surgical technique.

Whilst a recent systematic review [10] found that there was a paucity of prospective clinical studies regarding the management of PFT they did report better outcomes in patients receiving systemic antibiotics. They also found that limited entry into the flexor sheath with catheter irrigation for surgical debridement resulted in better range of motion outcomes than more aggressive surgical techniques. The benefit of antibiotics without surgery was not reported on due to a lack of data. However, DiPasquale et al. [9] recently presented a case series of 12 patients in whom early PFT was treated successfully with intravenous antibiotics in combination with elevation and immobilization.

The potential to manage early PFT without surgery presents the question of recognizing the diagnosis early, initiating appropriate antibiotic management and arranging suitable immobilization, monitoring and rehabilitation.

Table 2 Pang classification [13]

Group	Positive Kanavel signs	Presence of subcutaneous purulence	Presence of digital ischemia
I	Yes	No	No
II	Yes	Yes	No
III	Yes	Yes	Yes

Kanavel's cardinal signs [1] may not all be present, especially in the early stages of the disease, making early diagnosis challenging. There is no good research into the sensitivity or specificity of Kanavel's signs as a diagnostic tool. Kanavel's signs may allow the clinician to differentiate between PFT and alternative hand infections such as herpetic whitlow, septic arthritis, paronychia, felons, cellulitis, crystal arthritides and tenosynovitis [11]. The classification of "early" is also a matter for discussion with some authors describing this as within 48 h of inoculation [11, 12] whilst DiPasquale classifies early as "less than 3–7 days since the onset of symptoms" [9]. An alternative would be to consider staging of PFT according to severity. A classification system has been described by Michon in 1974 (see Table 1) but this is based on intraoperative findings, has yet to be validated and is not widely used

[12]. A further classification system has been described by Pang et al. [13] (see Table 2) based on pre-operative clinical assessment. This classification describes three groups of patients with PFT based on the presence of Kanavel signs, subcutaneous purulence and digital ischemia. They found that increasing grade was associated with worsening prognosis. This classification system has also yet to be validated. Pang et al. [13] also identified a number of factors that may be associated with a worse prognosis in PFT including age of more than 43 years, poorly controlled diabetes mellitus, peripheral vascular disease and renal failure.

Antibiotics should cover both Gram-positive cocci and Gram-negative rods, as well as accommodate local patterns of antibiotic resistance [11]. The monitoring of patients prior to intervening with surgery is also disputed. DiPasquale [9] monitored patients daily, looking for the presence of obvious pus in the hand on clinical examination; Draeger [11] recommends surgical irrigation if there is worsening or no improvement within 12–24 h and Hyatt [12] advises surgical intervention if no definite improvement is seen within 24 h. The duration of immobilization is also inconsistent between studies.

Outcomes following PFT appear to have considerably improved along with the availability of antibiotics. Grinnell [2] reported a death rate of 0.8% and an amputation rate of 8%—with one mid-forearm amputation and two upper arm amputations in a cohort of 125 patients. He also described osteomyelitis in 38% of patients and suppurative arthritis in 29%. Overall, he reported the end results as poor, with only 17% of patients reporting complete or nearly complete function. In comparison, a recent review by Giladi [10] reports 45% of patients returned to an excellent range of motion, increasing to 54% with the use of antibiotics with or without surgery. In patients treated with surgery alone only 15% of patients reported an excellent range of motion. When antibiotics and surgery were used in combination, the results differed considerably depending on surgical technique. Of those patients receiving systemic antibiotics and open drainage only 26% resulted in an excellent range of motion, compared with 75% of patients receiving antibiotics in combination with a catheter irrigation technique.

In summary, current evidence for the treatment of pyogenic flexor tenosynovitis is based primarily on case series and suggests that outcomes have improved considerably with the widespread use of antibiotics. Whilst traditional advice is for emergent surgical washout, our results suggest varied opinions regarding the optimal management of PFT, with some advocating a trial of intravenous antibiotics. Where surgery was advised, clinicians varied in their preferred surgical approach and the timing of surgical intervention. There also appears to be disparity amongst clinicians regarding the duration of immobilization during treatment.

The results of this study are based on hypothetical responses to three fictional scenarios. Whilst the scenarios were suggestive of mild, moderate and severe infections we may have obtained more robust results if we had referenced a grading system or classification. However, neither the Michon nor the Pang classifications have been formally validated and are not routinely used in the United Kingdom. The survey was distributed to a range of clinicians of varying specialty and seniority. This is likely to have increased the variation in response as both may affect previous education and experience.

Further research into the early diagnosis and most appropriate management of pyogenic flexor tenosynovitis would be welcome to help guide future treatment. The validation of a clinical classification system would be beneficial to help identify which patients may benefit from non-surgical or surgical management. We propose a multicenter retrospective analysis of current management and outcomes in PFT. The aim would be to use these results to establish the criteria for inclusion in a randomized controlled trial of surgical versus non-surgical management, along with appropriate management protocols for each arm of the study.

Compliance with ethical standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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