Kavel revisited – Hand infections at the turn of the century

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By the use of dissections and ingenious experiments, Allen Kavel clarified how hand infections spread along the various tissues and planes. This work enabled him to determine the best incisions to drain each type of infection and how to prevent its spread. Earlier, very little was known about how infections spread in the hand. Infections were often treated medically for long periods. Incision and drainage, when they were performed, in many cases were inadequate and focused in the wrong place. Even trivial infections often led to stiff useless digits or hands. Amputation and death were not unusual in the more serious infections. Representative cases are presented from Kavel's classic textbook *Infections of the Hand*, published in 1912.

Key Words: *Allen Kavel, Hand infection, History, Infection spread*

Kavel revu : les infections de la main au tournant du siècle

RÉSUMÉ : À partir de dissections et d'expériences ingénieuses, Allen Kavel a démontré comment les infections de la main pouvaient se propager à divers tissus et surfaces. Ces travaux lui ont permis de déterminer quelles incisions permettaient de drainer le plus efficacement chaque type d'infection et de quelle façon les prévenir. Auparavant, on en connaissait très peu sur la propagation de l'infection de la main. Les infections étaient souvent traitées pharmacologiquement et à long terme. L'incision et le drainage, lorsqu'ils étaient pratiqués, dans bien des cas, étaient incorrects et mal localisés. Même les infections les plus bénignes risquaient alors de conduire à une raideur des doigts ou de la main. L'amputation, voire le décès n'étaient pas rares dans les cas les plus graves. On présente ici certains cas représentatifs du manuel classique de Kavel, intitulé *Infections of the Hand*, publié en 1912.

Most hand infections nowadays are easily treated. If the infection is caught early, antibiotics will sometimes suffice. If the infection progresses or if it is more severe, incision and drainage (I & D) are indicated. In most cases the incisions used as those described by Allen Kavel, in his textbook *Infections of the Hand*, published in 1912 (1). (All page references following are from this reference.)

Kavel was Assistant Professor of Surgery at Northwestern University Medical School in Evanston, Illinois, and worked at Wesley and Cook County Hospitals in Chicago, Illinois. He became interested in hand infections early in his career and began to do research to increase his knowledge of

how these infections spread. He began by performing many dissections of hands. This was followed by injection of dyes into the various spaces of the hand such as tendon sheaths, the deep potential spaces of the hand and the bursae. Injections of radio-opaque dyes facilitated x-rays of specimens. Dye injections under pressure showed how such infections would most likely spread, ie, how an infection of the flexor tendon sheath could spread to the radial or ulnar bursae, or along the lumbrical spaces. From the studies and from his experience with hand infections, Dr Kavel was able to establish the signs and symptoms that help diagnose where deeper infections are located and the best incisions to drain them.

Until that time, because of inadequate knowledge of the various spaces of the hand and how infections could spread, trivial injuries or lacerations often ended up as disasters. Patients under the care of physicians or surgeons could end up

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with chronic, spreading infections despite various treatments, which often included inadequate or improper incisions for drainage. Many doctors looked on decreasing pain and sensitivity as a sign of improvement when these signs were actually caused by the increasing pressure of pus on the nerves. It was not uncommon for a patient with a minor infection of a digit or hand eventually to end up with immobile digits or a stiff, atrophic and useless hand. Sometimes, in desperation, digits or a hand – or even a forearm or arm – were amputated to try to halt the spread of a progressing infection. Eventual death in some of these cases was common. To show how horrible the care of hand infections was in the early 20th century, excerpts and case reports from Kavanell's textbook are presented here.

Paronychia, today usually considered fairly innocuous, often was not treated properly. "Among the infections of the distal phalanx is none so simple as the paronychia, or 'runarounds', and yet they frequently baffle treatment for some weeks, since the pathology may not be understood" (page 31). (Runaround was the term used to describe an infection that had spread to involve the entire eponychium.) After two or three weeks of inadequate treatment, such as various soaks, some pus might be expressed. One or two weeks later, the entire nail might be lifted off the matrix, while the latter developed a fungus-like elevation of granulation tissue. "This picture of the neglected case is not at all uncommon" (page 32). While patients often treated themselves with salves and ointments for a long time, physicians, most of whom were ill-informed, did not help the patient much either (pages 31-32).

Felons were usually not incised early, which led to problems.

It has been my experience frequently to open old felons in children and have the diaphysis fall out of the sac, where it has been floating, a free body, in a sea of pus. In adults, where osseous union has taken place, an examination will show the necrotic diaphysis standing out free from the surrounding tissue.... When the incision has been delayed or the process permitted to go on to spontaneous expulsion of the necrotic matter, we find a bluish, insensitive pus bag with a sinus opening which frequently appears at one side of the nail...fragments of seminecrotic connective tissue often appear partially plugging the opening (pages 28-29).

Carbuncles were also not drained properly in many patients. Kavanell's first case report is that of a patient who originally had a small pimple on the dorsum of the left hand. When he first saw the patient three weeks later, six small incisions had been made by the treating doctor in six separate areas at different times. The carbuncle now involved the entire dorsum and was extending volarly. In some cases, because skin necrosis had occurred, small Tiersch grafts were needed after a proper irrigation and drainage (pages 44-45).

It was with deeper infections of the hand that more serious functional losses occurred. Kavanell decried the tendency of some doctors to do an I & D at a swollen or tender area under the assumption that even if there was no pus there, the drain-

age would do good anyway. He also felt that an I & D of lymphatic infections could often do more harm than good because of secondary complications, and that I & D should be done only as a last resort. All hand infections were best drained under general anesthesia using a tourniquet to obtain a bloodless field (pages 74-75).

In another case report, Kavanell discusses a patient who, four weeks before admission, had cut his right hand on a piece of steel. He was in hospital elsewhere for four days and had apparently recovered from the infection. Numerous small pockets of pus developed on his fingers, which were opened by a surgeon. The hand began to swell enormously, and incisions were made on the dorsal aspect without evacuating much pus. The patient began to suffer systemic intoxication.

Examination on admission revealed a temperature of 101°, a pulse rate of 120 beats/min and a respiration rate of 26 breaths/min. Marked headache and emaciation were noted. There was general evidence of systemic intoxication. The right hand had swollen to two and a half times the normal size. The fingers were from 2.5 to 3.8 cm in diameter. The hand was at least 7.6 cm thick and swollen on both the dorsal and volar surfaces. The forearm was also slightly swollen.

Numerous incisions were noted on the fingers and dorsum, from which there exuded a moderate amount of pus. There was little or no tenderness of the hand. Because of a bulging palm and lack of evidence of tendon sheath involvement, a diagnosis of an abscess of the middle palmar space was made. An incision was made along the ring finger ray lumbrical. A cupful of pus was evacuated. At the end of five weeks, the patient had regained three-quarters of the function, and at the end of four months, full function of the hand (pages 220-223).

A second patient reportedly hurt his hand while rubbing meat and getting brine into the scratches one month before admission. The right hand was swollen with a bulging of the palm. Systemically, the patient showed evidence of toxemia, and was pale and weak. Urinalysis showed nephritis. An I & D of the midpalmar space was performed under anesthesia. A total of one-half pint of pus was evacuated from the space, with none noted in the thenar space or tendon sheaths. The patient's temperature varied between 99° and 101° degrees that day, rising to 102° the next day. He slowly became delirious. Over a month later, a metastatic infection of the extensor hallucis tendon was drained. The patient died two days later (pages 338-340).

Another patient was admitted three days after her hand became swollen and painful. There was no history of abrasion or possible entry of infection. Because the swelling was localized to the wrist and there did not appear to be tendon sheath or lymphatic involvement, an I & D was performed to drain the ulnar bursa, and pus was evacuated. Three days later, incisions were made more proximally along the forearm. A day later, the incision of the ulnar bursa was enlarged, and a large amount of pus was evacuated. Aspiration of a swollen knee joint revealed pus. The patient died eight days later. Autopsy revealed that the ulnar bursa was filled with

pus, as was the little finger's tendon sheath. The infection had spread to the midpalmar space, and was found under the profundus tendons and along the ulnar artery half-way up to the forearm (340-344).

In another case, a patient had removed a splinter from the distal phalanx of the thumb with a penknife seven days before he presented at the clinic (he also tried to remove another splinter two days after the first). The whole hand was swollen and tender both dorsally and volarly, and the distal forearm was affected. There was tenderness of the wrist along the ulnar bursa and the little finger tendon sheath, and along the flexor pollicis longus.

With the patient under anesthesia, incisions were made over the ulnar bursa and the lower third of the palm. The annular ligament (volar carpal ligament) was opened as well. Pus was found throughout and under the profundus tendons in the distal forearm. A separate incision was made along the proximal phalanx of the thumb and extended proximally to drain the pus of the flexor pollicis longus tendon sheath and radial bursa. Pus was also found under the profundus tendons in the distal forearm. Two weeks later, the little finger tendon sheath was drained. At the end of 12 weeks, the patient had almost complete function of all the joints and fingers, with the exception of the little finger in which he had only 25% function (pages 268-273).

Sometimes, even with adequate drainage one could not stop the infection from spreading proximally, as in the example of one patient who was admitted with symptoms of supuration of the tendon sheaths in the carpal area and the forearm. I & D revealed pus under the tendon sheath of the thumb, but not the little finger or ulnar bursa. One week later an I & D was performed in the forearm because of evidence of proximal spread of the infection. Pus poured from a small capsular hole between the cuneiform and pisiform. Another I & D along the flexor pollicis longus tendon revealed a lot of pus as well as necrotic tissue. The next day, a lot of pus was noted in the wrist and upper arm. After several I & D procedures, necrotic carpal bones were removed. Four days later, the patient's arm was amputated. The patient died the next day (pages 397-398).

In one series of serious hand cases of all types treated elsewhere, the mortality rate was 22%. It was higher in older patients and worse if nephritis or chronic systemic disease was present. At Cook County, because so many of the patients were 'social derelicts' the mortality rate was higher than in private hospitals.

If symptoms of toxemia did not subside in three days, or within two days of having drained foci, or if no localized process had developed, anxiety would be felt for the patient. Streptococci and certain gas bacilli usually caused more serious infections. A brisk onset with high fever and chills was a bad sign. Ill advised and premature incisions could turn a moderate infection into a more serious one (pages 347-348).

In cases of tenosynovitis of the flexor tendon sheaths, unless early proper treatment was instituted, flexion of the phalanges would be lost although that of the MP joints could

probably be preserved. To prevent proximal spread of infection, incisions should be on the radical rather than on the conservative side, on one or even both sides of the tendon sheath, ie, mid-laterally. If the infection spread, more proximal incisions would also be needed to drain the radial or ulnar bursae, or thenar or mid-palmar spaces (pages 298-300).

If not treated early, besides spreading more proximally, tendon sheath infections would often cause necrosis of the tendons, osteomyelitis or a septic joint. In most cases the middle phalanx or the proximal interphalangeal joint was involved. Treatment could require drainage, curettage or more radical treatment. If tendon sheath infections were improperly treated, infection could spread to the smaller bones of the hand, causing osteomyelitis or necrosis of the carpal bones or proximal metacarpals.

One typical chronic case was a woman who developed a web space infection between the middle and ring fingers. She was under the care of a 'magnetic healer' for seven weeks before going to a physician who did an I & D for a sinus tract. Twenty-one days later a second dorsal sinus tract occurred, and within 10 days, 15 other sinus tract infections appeared. She again presented to the physician who drained all the pockets, allowing her to make a slow recovery. A second operation to release adhesions did not increase the limited movement of the fingers and wrist. Kavanell felt that the original web space infection had spread by direct or lymphatic extension along the lumbrical canals into the midpalmar space and from there to the base of the index finger. The ulnar bursa became involved as well. Such infections often lead to a claw hand and limited movement of the digits or wrist (pages 431-433).

A rare but serious complication could occur when the infection spread to the forearm. It could then spread proximally along the arteries, usually the ulnar artery. If the vessel became infected, it could cause a sudden, profuse hemorrhage, which would usually be treated by compression. This would stop the bleeding temporarily. However, this was not the proper therapy, because the hemorrhage would recur. The only course was to do immediate surgery and ligate the artery in order to prevent further hemorrhage, shock, or even death which could happen if the bleeding started while the patient was asleep and it was not discovered in time (pages 401-402).

It is because of his dedicated work in the field of hand infections that surgeons following Kavanell were and still are able to avoid the drastic complications that can occur after any hand infection. Even with the advent of antibiotics, it is the proper drainage of these infections as described by Kavanell that is still the mainstay of treatment.

REFERENCE

1. Kavanell AB. Infections of the Hand. Philadelphia: Lea and Febiger, 1912. Reprinted as a Special Edition of the Classics of Surgery Library, Division of Gryphon Editions, New York, 1992.