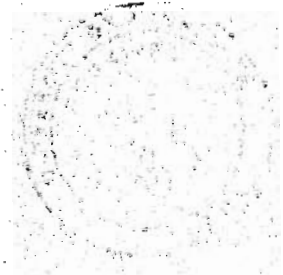


Bulletin of  
**Staff Meeting**  
Minnesota General Hospital  
University of Minnesota



Vol. V  
No. 4  
10-26-33

Hand  
Infections

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**I. ABSTRACT****HAND INFECTIONS****References:**

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**History:**

The word "panaritium" (paronychia) and various derivations are found in the Arabian and other ancient writings. Knowledge of lymphatic vessels dates back to Aristotle, to Herophilus (300 B.C.) and to Herasistratus (280 B.C.). These fragments of knowledge were not improved on materially for a lone time. and it was not until 1859 that any treatise on hand infections appeared. Sappey (1876) published his large atlas on lymphatics. During this period, there was a wave of anatomical interest in hand infections (Gosselin, Dolbeau, Chevalet, Polaillon and Le Dentu). Since then, there have been only a few significant works (Tornier 1891, Forssell 1903). Kanavel more recently has made a study of the problem. The results of his work appear now in book form (1925) and his studies are being continued by his students.

**Economics of Hand Infections:**

The following heterogenous groups of

statistics show prevalence, morbidity, effect of prophylactic care, etc.

1. In 4971 injuries (hand), 654 or 11% became infected and the total disability from these accidents was 13,000 days of which 20% was due to infections.

2. In one stockyards plant, it was found

(a) 75% of disability is result of infection and only 25% is result of other causes, such as broken bones, etc.

(b) 75% of hand deformities are results of infection.

(c) 90% of the infections report for treatment after the process has started.

3. 5 largest accident insurance companies:

(a) 15% of total disability (all types) is due to hand injuries.

(b) 7 - 9% of above is due to hand infections.

(c) Of all hand injuries, 65% requiring disability rating are the results of minor injuries which have become infected. 35% requiring disability rating are due to the other injuries such as broken bones, lacerations and crushing injuries.

4. In general, company surgeons are agreed that:

(a) Hand injuries cause a high percentage of the disabilities.

(b) Over 50% of deformities are result of infected injuries.

(c) Severe hand injuries are seldom infected (hospitalization or professional care is forced on the injured).

(d) Minor injuries are most common cause of infections (do not report

for care).

### Bacteria:

The bacterial agent in hand infections is nearly always staphylococci or streptococci. Of interest is the following data taken from the same group of 11,000 employees during two-month periods.

	<u>During Average Time</u>	<u>During Tonsillitis Epidemic</u>
Total tonsillitis	327	603
Total hand infections	83	117
% of hand infections having tonsillitis	18%	28%

The incubation periods worked out in large series of cases are: paronychia 1 to 8 days, subepithelial abscess 1 to 4, felon 3 to 10, carbuncle 2 to 4, lymphangitis 1 to 2, tenosynovitis 3 to 6, fascial space infection 3 to 6, axillary abscess 3 to 7.

### Prevention:

The prevention of hand infections found to most efficient is as follows:

1. Constant propaganda campaigns to everyone for removal of causes found in working places (examples - removal of exposed nails or wire, pins in packages, broken odds and ends, etc.).
2. Removal of causes to be found in the individual (tonsillitis, anemia, undernourishment, etc., i.e. periodic health examinations).
3. Prevention of fellow-workers applying inefficient first aid.
4. Immediate treatment by physician of all injuries. In absence of physician a well-trained nurse is next recommended and if this is impossible, treatment by one fellow-worker especially designated and coached, is recommended.
5. The treatment consists in

application of tincture of iodine. The use of hydrogen peroxide, bichloride wash or soap and water is never indicated. These methods infect the wound. The results obtained by these methods are shown by this data:

<u>Year</u>	<u>Injuries</u>	<u>% Infections</u>
1912	2693	28.6
Method began		
1913	4383	7.5
1914	4971	11.0

When the treatment becomes a question of ambulatory (conservative) or hospital (radical) care, Kanavel (quoting Mock) is "convinced that a radical form of treatment of all hand infections is the most economical plan that can be adopted."

### Types:

1600 hand infections were caused by the following, named in order of frequency: pin pricks, splinters, abrasions (from boxes, etc.), lacerations (from sharp tools), bruises and contusions, nail wounds, scratches (tin and wire).

The types of infections encountered in large groups are:

1. Ambulatory: paronychia 90, superficial abscesses 82, superficial subcutaneous infections 45, carbuncles 20, lymphangitis 13, felons 10, collar button abscesses 3; total 253.
2. Hospital: lymphangitis 59, felons 24, tenosynovitis 24, superficial abscesses 14, collar button abscesses 7, carbuncles 5, mid-palm fascial infection 5, paronychia 5, thenar space infection 3, hypothenar space infection 2; total 146.

In dealing with the question of hand infections, everyone (Kanavel) must recognize that he is dealing with a great economic problem and that much depends on his ability to cope with it

properly. From the viewpoint of the infected individual, his future earning capacity is often at stake--." Kanavel is positive that the proper approach to the problem is through complete understanding of the anatomy of the hand and hand infections.

### Anatomy and Pathogenesis of Hand Infections:

Because the subject is extensive, certain phases must be briefly summarized and some will be omitted entirely (osteomyelitis, joint infections, lymphangitis, chronic infections).

#### 1. Felons:

The anatomy of the distal phalanx is peculiar in that the fibrous tissue forms a closed sac about the ends of the fingers which is subdivided by septa and intimately attached to the bone. The blood vessels pass through this sac parallel to the bone. Pus and edema developing in this space have no egress and the sac is not distensible. The undue pressure shuts off the blood supply and necrosis results. The epiphysis (and joint) is uninvolved because it receives blood supply before the vessels enter the terminal closed sac. Treatment must consist of adequate incision as soon as hardness develops (i.e. after lymphangitis is ruled out and localization is present) and before the board-like hardness of a pus collection is present.

#### 2. Paronychia:

The infection is under the overhanging edge of the nail. Pus extends around the nail sulcus. The delicate nail root is entirely raised off the nail bed, although the distal part of the nail is still firmly attached.

The treatment (Kanavel) consists of a longitudinal incision along the outer edge of the nail, going back to the base as far as the sulcus with care to cut to the outside so as not to cut the nail bed or the overhanging cuticle, since if this is done it may result in a permanently split nail. The eponychium is pushed back to expose the base of the

nail and from the side the point of a scissors is inserted under the detached edge of the nail and this is cut away to the extent to which it has been undermined. The elevated cuticle is packed with a strip of vaseline gauze and hot moist dressings are applied for a few days. The procedure may be done on one or both sides of the nail depending on the extent of the process.

#### 3. Carbuncular infections:

Infection begins in either a hair or sweat gland. It penetrates along this structure through the columnae adiposae of the skin to reach the subcutaneous fat layer. Here, it spreads laterally reaching the bottom of adjacent columns and their contained glands. It ascends through these toward the skin "straining through a sieve, as it were." The center becomes necrotic and the periphery drains pus through numerous openings.

Treatment consists of two crucial incisions extending beyond the edge of the carbuncle and lateral incisions through the base of the flaps parallel to the skin at the depth of the fat layer, again beyond the edge of the infected zone. The flaps are elevated by vaseline packs and hot moist dressings applied. Only free sloughs are removed. No curetting is done. The reason for incision beyond the point of infection is unknown but its necessity has been learned by experience of the author. (Quoted).

#### 4. Collar-button abscesses (shirt stud abscess) (Frog felon):

This infection begins in the skin and subcutaneous tissue of the web of the fingers. The deep fascia of the hand under these areas is thin and frequently the interlacing of the fibers leaves apertures filled with fat which is continuous with that above and deep fascia. The infection passes through the apertures and spreads out under the deep fascia.

Treatment necessitates a search in all web infections for the second

pocket deep to the fascia (by probing). If it is present, the deep fascia must be split to give adequate drainage to the deeper pocket.

##### 5. Synovial and Fascial Space Infections:

These infections are the most important of any involving the hand because of their frequency and severity. Kanavel's anatomic studies are based on dissections, cross-sections and plaster-of-paris injection specimens.

These are present in the hand synovial sheaths and free fascial spaces. Infections travel along these pathways in a fairly definite manner. Incisions properly placed cure the disease; those placed improperly spread the infection and injure the patient.

The spaces on the dorsum of the hand may be disregarded in this discussion except as mentioned above. Furthermore, it may be said that there is no communication between the palm and the dorsum except, as will be mentioned, through lymphatics and through the finger webs including the web of the thumb. This fact removes all anatomical basis for any incisions on the back of the hand.

The palmar synovial sheaths are five in number, one for each finger. The sheaths for the index, middle and ring fingers end just proximal to the metacarpal-phalangeal joint. The sheaths of the thumb and little finger are continued into the palm and wrist and end proximal to the annular ligament of the wrist. The prolongation beyond the digit proper is known as ulnar and radial bursa respectively. The bursa is ordinarily larger than its corresponding sheath. Anatomically, the sheath and the bursa may be divided by a thin membrane (approx. 1 - 20) but practically this may be disregarded since infections break through the dividing membrane. The proximal ends of the ulnar and radial bursae are in communication anatomically, in 50% of the cases by two or more "intercommunicating sheaths." Clinically, again, the communication may be regarded to exist in all cases because any infection of one over 36 to 48 hours duration produces

extension to the other regardless of anatomical variations.

The superficial arch overlies the bursae. The nerve to the thenar muscles crosses the radial bursa a finger's breadth distal to the annular ligament and superficial to the sheath. In the palm, the sheaths overlie the palmar spaces and form part of their wall.

The lumbrical canals consist of the lumbrical muscles and the loose tissue about them. These muscles arise from the flexor tendons and insert into the phalanges. The canal lies to the side of the synovial sheath and parallel with it. In the palm, the canal enters into the roof of the fascial spaces.

##### Extensions of infection from the Synovial Sheaths:

Infections of radial or ulnar sheath passes into (1) the palmar spaces, (2) into the opposite ulnar or radial bursae, and (3) into the forearm. The infections of the sheaths of index, middle and ring fingers pass into the palmar spaces either directly or by way of the lumbrical canals.

The significant palmar spaces are two in number: middle palmar space and the thenar space. These spaces are formed by the muscles and adjacent fascial arrangements. There is an opening into the web of the fingers along the lumbrical canals and the superficial position of the thenar space at the web of the thumb is to be noted. It should be carefully noted that the two bursae are separated from each other along the line of the axis of the middle finger. In case of infection of only one space, incisions must not cross this line, and probes or forceps should not be passed through this septum.

The path of infection into these spaces from the synovial sheaths has been described. The further spread is quite uniform. (1) The lumbrical canals are involved and the pus extends to the webs of the fingers and may "point" on the dorsum of the web. (2) The infection

may break through the septum and involve the opposite space. (3) The proximal walls of the spaces are thin and readily break allowing passage of pus into the forearm. (4) In case of the thenar space, in addition to the above lines of extension, pus may pass between or over the heads of the adductor and extend into the dorsum of the web of the thumb. (For further details see Kanavel).

#### Spaces of the forearm:

Regardless of the source of extensions of infection to the forearm, i.e., sheath or bursa, the path and position of pus collections is the same. As stated above, the involved spaces in the palm and wrist lie deep to the tendons. They enter the forearm in this same position and therefore lie on the pronator quadratus and deep to tendons and muscle. They become superficial on the lateral borders of the radius and ulna along the lateral intermuscular septae.

In passing upward, the infection extends in spaces anterior to the interosseous membrane. As muscle bellies develop in the midpart of the forearm, dissection between these takes place. In general, the position of the infection is between the superficial and deep muscles. It is to be noted that purulent collections approach the surface between the flexor carpi ulnaris group and the superficial flexors. Also, it is to be remembered that both the ulnar nerve and vessels and the median nerve are grasped by projections of the pocket. If the pus is not evacuated, dissection downward along these nerves and vessels may take place. Atrophy and necrosis result from injury to these structures.

The incisions into the infected areas are entirely on anatomical basis governed by the line of extension but not by the gross appearance of swelling, etc. The point of maximum swelling and pain and the point of proper incision do not necessarily correspond.

The synovial sheaths are opened on the lateral side and not over the front. The distal phalanx need not be incised and depending on the extent the proximal end of the sheath may be opened. This

incision extends three-fourths of inch proximal to the metacarpal-phalangeal flexion crease. Allowance must be made for the thenar nerves over the radial bursa. The ulnar bursa apparently is opened, when involved, separately from the opening of the sheath proper.

The thenar space can be opened most readily through the web of the thumb. The incision is placed behind the web because function is better with the scar in this position.

The middle palmar space is opened along the lumbrical canals. Since this infection is usually associated with a sheath infection, the incisions are carried from the sheath into the distal part of the palm (three-fourths inch) over the lumbrical muscles. A forceps passed from this point beneath the tendon will open the space.

Infections extending into the proximal part of hand as into distal forearm are opened along the lateral septae. Anterior incisions through annular ligament of wrist are rarely necessary. In the middle of the forearm, the optimum point of incision is usually the same.

The infections of the hands, the number and extent of the incisions is governed by the spread. The position of each separate incision, however, is constant.

#### Symptoms, Signs and Diagnosis:

The synovial sheaths, palmar and forearm spaces are more or less individual areas. Infections spreading through these present, therefore, a confusing picture resembling that of multiple individual diseases superimposed on each other. Infections of the hand in this way are not infections of a single organ but rather of individual areas and the signs must be analyzed as such.

#### Certain general leads may be followed:

1. The anatomical boundaries of each space must be known.

2. The probable lines of extension from each space must be known.

3. The signs from a space infected by extension are superimposed upon those of the first.

4. The systemic reaction is of no great help in diagnosis.

5. Local pain is often misleading because pressure produces anesthesia.

6. Fluctuation cannot often be detected because of the deep position.

The cardinal signs of tendon sheath infection are:

1. Excessive tenderness over the course of the sheath, limited to the sheath.

2. Symmetrical enlargement of the whole finger.

3. Excruciating pain on extension of the finger.

4. Finger held in flexion.

In ulnar bursa infection, the most conspicuous and valuable additional sign is exquisite tenderness at a point over the tendon just proximal to where the distal flexion crease in the palm joins the hypothenar area.

Middle palmar space infection produces an obliteration of the palmar concavity. This is absent in any other type of infection.

Thenar space infection is evidenced by ballooning out of the web of the thumb. The concavity of the palm is not obliterated.

Forearm infections produce deep induration. Fluctuation rarely is present because of the deep position of the pus.

Ballooning of the dorsum is almost constant accompaniment of any palmar infection. It is due to secondary lymphangitis and to edema. With the exception of collections of pus in the webs of the fingers and thumb in certain cases, ex-

tension of the abscess to the back practically never occurs. The edema should not be incised.

After Treatment:

Drains. Rubber tubes are never used. Catheter tips for Dakin's irrigation may be laid in the wound. Gauze after a few hours "acts as a plug." Rubber or gutta-percha strips or vaseline strips may be left in the wound. "In most cases, all drainage material if used is omitted after 36 to 48 hours."

Position. A plaster-of-paris "cork-up" splint is used to immobilize, to prevent prolapse of tendons and to maintain a position of function. The hand is never allowed to simply lie in the dressings.

Bier's method of constriction is used in all acute cases. It is applied before operation and gradually released over 12 to 24 hours. It seems to prevent rapid absorption of toxic products stirred up by the operation. It gives a bloodless field and is considered a necessary adjunct to operation.

Anesthesia. General nitrous oxide in all cases.

Dressings. Hot moist dressings for 24 to 48 hours and dry heat thereafter. Inner dressing is of vaseline. Changed twice daily. Strict asepsis is required in all dressings. Strong antiseptics never used. While boric acid is used in the moist dressing, no significance is attached to the small quantities which may be absorbed.

Physiotherapy consisting of passive motion, massage (late), immersion in hot sterile water, etc. done as soon as danger of systemic infection is over, "ordinarily within 48 hours after the primary incision."

SUMMARY:

1. A wave of interest in hand conditions occurred between 1860 and 1900. Since this time, Kanavel's studies have become authoritative, the world over.



2. Statistical data emphasizes the economic loss due to hand infections.

3. The greatest single factor is neglect of the primary injury.

4. Minor injuries are cause of serious trouble more often than extensive ones because the latter are not neglected.

5. 11% of wounds become infected: 15% of hand deformities are due to infections and 7 to 9% of all disabilities are due to hand infections.

6. The causative organisms are the usual pyogenes group. In tonsillitis epidemics, the incidence of hand wound infections increases probably due to increased chance for contamination.

7. (a) Ambulatory: paronychia 90, superficial abscesses 82, superficial subcutaneous infections 45, carbuncles 20, lymphangitis 13, felons 10, collar button abscesses 3; total 253.

(b) Hospital: lymphangitis 59, felons 24, tenosynovitis 24, superficial abscesses 14, collar button abscesses 7, carbuncles 5, mid-palm fascial infection 5, paronychia 3, thenar space infection 3, hypothenar space infection 2; total 146.

8. The most efficient methods for prevention of infections in factories is removal of the mechanical causes of trauma, prohibition of self or fellow-worker treatment and immediate care by a physician.

9. The incidence of infection in one organization dropped from 28.6% to 7.5% under this plan.

10. In a well handled group of 399 infections, 146 were treated in the hospital and 253 were treated by ambulatory methods.

11. Whenever any doubt whatever is present as to advisability of the two methods of treatment, hospitalization is cheapest and most efficient.

12. The diagnosis and treatment of all hand infections is on a purely

anatomical basis.

13. In felons, the closed sac arrangement of fascia in the terminal phalanx causes the development of a high pressure followed by anemic necrosis.

14. The dissection of the nail bed for paronychia is outlined.

15. Carbuncles owe their peculiar form to the arrangement of follicles and fat layers.

16. Collar-button abscesses assume their form because of defects in the fascia of the web of the fingers.

17. Synovial sheath and fascial space infections are the most important of all those involving the hand.

18. The anatomy of these structures is quite constant and only a few variations are present.

19. The infection spreads through the spaces in a definite sequence and the course and localizations may be prognosticated. The same is true of infections spreading to the forearm.

20. The incisions into the various spaces have become standardized. English, German and other American writers describe Kanavel's incisions without variation.

21. "Lancing" the hand is now spoken of as belonging to the barber surgeons. The incisions are dissections done in a bloodless field under general anesthesia.

22. The various spaces are quite independent of each other. The signs of infection of each space are superimposed upon that of the others as though it were a separate infection. This produces a confusing picture.

23. There are a few characteristic signs in each type of infection. These are reviewed.

24. All operations are done with a tourniquet on the arm. After opera-

tion, this is changed to a Bier's passive congestion treatment for a period of 12 to 18 hours.

25. Drains are not used in every case and in all, when used, are removed after 36-48 hours.

26. Wet dressings are discontinued after 24-48 hours and dry heat and passive motion begun.

## II. CASE REPORT

### TENOSYNOVITIS OF RIGHT FOURTH FINGER WITH EXTENSION

Case is of white male, 53 years old, admitted to Minnesota General Hospital 1-24-32 and expired 2-12-32 (19 days).

History prior to admission essentially negative. Had measles, mumps, and chickenpox in infancy. Occasionally had precordial pain. Only other illness is varicose veins.

#### Sliver

1-21-32 - While carrying wood, ran sliver into middle phalanx on palmar surface of 4th finger. Pain no attention to incident.

#### Infection

1-23-32 - Observed pain in finger and palm. Had fever in evening.

#### Admission

1-24-32 - Observed swelling in palm and back of hand. Pain in finger and palm.  
Admitted.

#### Physical Examination:

Pencil-point tenderness of palmar space. Swelling of back and front of hand with marked pain on movement of 4th finger. No lymphangitis, epitrochlear or axillary node involvement. Remainder of physical examination negative except for some varicosities, especially of right leg. Laboratory: Urine - negative. Blood - Hb. 81%, wbc's 15,500, Pmn's 83%. Progress: Temperature on admission 100.8.

Taken to operating room.

#### Operation

Preoperative diagnosis - tenosynovitis of flexor tendon sheath of 4th finger, right hand and midpalmar space infection of same. Anesthesia - ethylene. Procedure - transverse incision made just proximal to distal phalangeal flexion crease of 4th finger. Incision carried longitudinally along each border of finger down to middle phalangeal flexion crease, but not across this. Dissection carried down to flexion tendon sheath. Tendon sheath slightly distended and contains pus; incised longitudinally. Second transverse incision made just proximal to midphalangeal flexion crease. Flap raised back as in previous phalanx, just laying bare the tendon sheath. Tendon sheath at base of finger found to be necrotic and somewhat thicker purulent material exudes. No involvement found in midpalmar space. Drains inserted. Procedure done with tourniquet around arm.

1-25-32 - Hot packs kept on hand continuously. Temperature 102.5.

#### Reoperated

1-26-32 - X-ray of hand - shows soft tissue infection, no presence of osteomyelitis. Temperature 103. Taken to operating room. Incision lengthened and deepened down to flexor tendon in palm. Midpalmar space again explored. No pus found. Longitudinal incision made on radial side of index finger on dorsum of hand. No pus found.

#### Forearm Involved

1-27-32 - Temperature 100.2. Taken to operating room. Preoperative diagnosis - tenosynovitis. Anesthesia - ethylene. Procedure - hand swollen, draining thin pus. Tenderness in region of wrist and ulnar bursa. Two areas of tenderness in forearm. Therefore, incision made in lower forearm, one on radial side, another on ulnar side, located about 1.5 inches or more above wrist joint, forceps introduced and carried through under flexor digitorum profundus tendon. Two incisions made in forearm over tender areas but no pus

encountered.

1-28-32 - Temperature 103.2

1-29-32 - Taken to operating room.  
Forearm again incised.

Pulmonary Signs. Necrosis of vessels

1-30-32 - Temperature ranges from 101 to 102.2. Patient irrational and coughing. Chloral hydrate given (R). Placed in restraints. Considerable loss of blood from operative incision.

Progressive Toxicity

2-1-32 - Temperature 102. Irrational. No chest findings. Urine - numerous casts.

2-2-32 - More irrational. Blood - Wbc's 18,500.

2-3-32 - Considerable bleeding from incision. Temperature 99.8 to 102.

2-4-32 - Still irrational. Chest negative. Pus oozing from all incisions. Slight bleeding.

Hemorrhage - Ligation - Transfusion

2-5-32 - Profuse bleeding from hand. Taken to operating room. Ligation of radial artery done under general anesthesia. Transfusion of 500 cc. citrated blood.

2-7-32 - Serum and pus draining from wound. Temperature 98.6 to 101.8. Blood culture negative. Chest examination negative. X-ray of chest - heart pushed over to left; some consolidation at left base.

2-8-32 - Very much weaker. Pulse irregular. Temperature suddenly rose to 106. Chest findings minimal.

Chill

2-9-32 - Has chill. Temperature 105.

Transfusions

2-10-32 - Involuntary and restless. Back of hand incised. Right hand and left lower lobes of lungs show rales and bronchial breathing. Given 400 cc. citrated blood. Temperature 106. Blood - Hb. 43%.

Positive Blood Culture - Streptococci.

2-11-32 - Given 700 cc. citrated blood. Temperature 104. Blood culture shows streptococci.

Exitus

2-12-32 - Irrational and stuporous. Respirations labored and rapid. 7:20 P.M. expired.

Autopsy

Body is of very large, well-developed, fairly well-nourished, white male, 53 years old, measuring 162 cm. in length and weighing about 190 lbs. Rigor marked. Hypostasis purplish and posterior. No edema, cyanosis or jaundice. Pupils equal and regular.

Twelve incisions about right hand and forearm. On dissection, all fascia planes of hand and arm have been exposed. No collection of pus. Artery ligated at elbow. Tendon of 4th finger is sloughed away and lying loose within wound.

Peritoneal Cavity entirely negative. Appendix normal.

Right and left diaphragms at 4th interspace.

Empyema

Moderate empyema in right Pleural Cavity of about 300 cc. turbid, cloudy material. Left pleural cavity normal. Pericardial Sac normal.

Endocarditis

Heart weighs 525 grams. Definite hypertrophy of ventricles. Valves of heart show recent vegetations on tricuspid and mitral valves. Root of Aorta normal. Coronaries negative.

Pneumonia

Right Lung weighs 900 grams, Left 1000. Both lungs very large and heavy. On cut section, both exude a large amount of fluid and blood. Except for red atelectatic portions, cut surface of lung is gray, edematous and infiltrated with exudate. In right lung just under pleura on lateral aspect is a small, yellowish nodule about 0.5 cm. in

width with a softened center which might possibly be source of empyema.

Spleen weighs 460 grams, is very soft, flabby and pulp scrapes easily.

Liver weighs 2800 grams, is soft, yellowish in color and appears fatty.

Gall-bladder, Gastro-Intestinal Tract, Pancreas, Adrenals, Genital Organs normal.

Right Kidney weighs 250 grams, Left 265. Cortex swollen and pale yellowish.

Prostate not enlarged.

Aorta shows very little sign of arteriosclerosis.

Organs of Head and Neck - not examined.

#### Diagnoses:

1. Streptococcic infection of right hand and forearm.
2. Streptococcic septicemia (clinical).
3. Acute endocarditis.
4. Empyema of right pleural cavity.
5. Bronchopneumonia and atelectasis of both lungs.
6. Abscess of lung.
7. Septic spleen.
8. Fatty liver and kidneys.
9. Multiple incisions of right hand and forearm.

- Rudolph Koucky

### III. HOSPITAL MORTALITY AND MORBIDITY (5 Years).

#### HOSPITAL MORTALITY:

In addition to case reported today, there were 3 other deaths during past 5 years, i.e., 34 cases - 4 deaths.

1. C.L. 5-24-29 (21 days). White male, 44, had pimple on right middle finger for one week followed by abscess in right hand which was very tender and swollen. Swelling and inflammation ex-

tended into right upper extremity. Physical examination on admission revealed entire forearm markedly swollen, with redness and edema extending to level of insertion of deltoid muscles. Most of swelling of hand was confined to dorsum of hand and wrist. Tenderness marked over dorsum and lower one-third of forearm. No point of tenderness made out in palm.

There was a small incision about 1 inch in length over dorsum of hand from which pus exuded. All signs and symptoms appeared to suggest localized infection of dorsal subcutaneous tissue. Incision made from base of middle phalanx of middle finger (primary focus) across dorsum to 3 inches above wrist extending through annular ligament. Large amount of pus was found to dissect under the subcutaneous tissue of entire hand and lower portion of forearm. Careful dissection and incision of spaces. Wound was left open. Hot packs applied.

Temperature subsided only temporarily and it was apparent that he was developing septicemia. Blood culture showed streptococci. Condition did not improve; he had difficulty in breathing. Abdomen became tense and signs of peritonitis were evident. It was considered inadvisable to do a laparotomy. Condition grew worse. Patient expired on 21st day of illness in hospital (28th day of course).

Postmortem examination showed empyema and generalized peritonitis.

Diagnosis: Septicemia.

2. J.M. 10-4-32 (8 days). White male, 26, on admission gave history of lacerated wound on right 3rd finger 10 days ago. 3 days before admission developed pain in chest, abdomen and extremities with stiffness of jaw and muscles of body. Physical examination revealed marked muscular rigidity of entire body, especially marked of jaws. Leucocyte count 19,800. Treated with massive doses of tetanus antitoxin intraspinally, intravenously and intramuscularly. Total of 450,000 units in a few days. Also necessary to give evertin and chloral hydrate. On 6th day

developed cough, fever and it was thought bronchopneumonia was present (substantiated by x-ray examination). On 9th day, was getting along very satisfactorily. Muscles were much more relaxed. Pneumonia was clearing. Wanted to eat and was anxious to know when he could go home. About noon, suddenly developed temperature of 106 and expired one hour later.

No postmortem examination.

Diagnosis: Tetanus.

3. A.P. 6-27-31 (4 days). White female, 30. Fifteen days before admission and 19 days before death, ran sliver into right index finger. 10 days after primary injury, jaws began to get stiff. Next day, unable to move jaw, began to have jerking sensation in arms and legs. On 13th day, pain in neck and back with some stiffness. Admitted to hospital next day. Physical examination: Muscles of mastication were tightly contracted. Marked opisthotonus. Short clonic contractions of upper extremities when disturbed. Leucocyte count 14,350. Spinal puncture - fluid clear, pressure 220. Given 90,000 units of tetanus antitoxin over next few days. Other treatment - magnesium sulphate (intramuscularly), chloral hydrate and avertin (rectally). Began to grow worse. On 2 or 3 occasions, had difficulty in breathing. Diaphragmatic breathing continued, practically no intercostal movement.

Postmortem showed only congestion of viscerae and puncture wound of right index finger.

Diagnosis: Tetanus.

#### HAND INFECTION SURVEY:

Summary of available records (cross-index) of hand infections which have been hospitalized in five-year period, July 1, 1928 to July 1, 1933. There are 30 cases, of which 23 (78%) are males; 8 of entire group were involvement of the index finger. The high incidence of males is in agreement with other statistical reports on hand infec-

tions; it is usually attributed to increased exposure to occupational hazards of males. However, another factor probably plays a role when it is noted that one-half the total cases of hand infections requiring hospitalization occurred following trivial injuries, such as scratches, pin pricks, small puncture wounds, etc. One might suppose that women were exposed to these types of injury as much as men but the factor of cleanliness may determine the smaller incidence in females.

Among the etiological factors, other than the minor trauma, were: paronychia 5, human bites 3, cat bites 1 (see discussion), fungus infection 1, tuberculosis of carpus 1, gonococcal infection of carpus which was misdiagnosed and treated as a non-specific hand infection, 1. Out of the total of 30 cases, there were only 3 following major injuries - 1 trauma in a corn husking machine, 1 cut with a silage knife, and 1 saw injury. Average duration prior to admission to hospital was 28 days, suggesting that this group of cases were (1) improperly treated, (2) did not respond to proper treatment, or (3) were unusually severe types of disease. The average stay in the hospital was 3 weeks, the longest being 108 days (human bite infection) and another - 50 days (human bite infection). In groups according to the part of hand involved, there were: 12 tendon sheath infections, 6 infections of mid-palmar space, 5 paronychia, 4 acute cellulitis, 3 of thenar space, 1 with combination of ulnar and radial bursa involvement, and 1 case with severed tendons. There was bone involvement or osteomyelitis in 11 of 30 cases. Of this number, grouped according to etiology, 3 were felon, 2 of the 3 human bite infections had osteomyelitis, 2 paronychia, 1 tuberculosis, 1 Neisserian infection, 1 puncture wound, 1 in which the trauma was from a Scotch thistle in the palm of hand. Twenty of the 30 cases had x-ray examinations of which 13 showed positive x-ray findings and 1 had gas in the soft tissue. Twelve cases had bacteriological reports, the majority of the cultures being mixed bacterial flora with streptococci in 10 of 12 cultures, 2 cases showed fusiform

organisms (human bite infections). There were 3 blood cultures, one definitely positive showing streptococci and one questionable showing a gram+ rod.

In summarizing the treatment, 12 of the hospitalized cases had had incision and drainage prior to admission. All of these required further incision and drainage in the hospital, 6 of the cases required only 1 incision with drainage during their hospital stay, 17 cases (56%) required multiple incisions up to as many as 8 in one case and 5 incisions with 2 amputations in another before the hand infection was controlled. The latter case was also a case of human bite infection. Five amputations of fingers or hands were necessary after incision and drainage. One of the hand amputations was in a human bite infection and one for tuberculosis. There was a total of 8 amputations including amputations of terminal portions of the fingers and 4 sequestrectomies for osteomyelitis. It is of interest to note that 2 cases had secondary hemorrhage after incision and drainage, of such severity as to cause shock and require transfusions and ligation of the radial artery for control of the bleeding. Among the complications was one case of bronchopneumonia in a case which had a positive blood culture and one abscess of the buttocks in a second case with a positive blood culture, which required drainage. There were no deaths among this group of 30 cases. No definite conclusions can be drawn from such a small group of cases and furthermore because this group does not represent a typical cross-section of the cases of hand infection (rather the more severe or chronic, intractable group).

#### Impressions:

1. 50% of the cases of severe hand infections result from what might be regarded as trivial injuries. The long duration, 28 days prior to admission, and the fact that 56% of the cases after hospitalization required multiple incisions and several amputations before the hand infection was under control would indicate that more adequate primary incisions were indicated. This impression

may not be warranted, as previously pointed out, as this group represents a rather select type of cases. If the hand infections seen in the Out-Patient Department could be studied with this hospital group, entirely different impressions might be gained. More cultures and more attention to taking of cultures should be stressed. The possibility of secondary hemorrhage should be borne in mind at the time of the operative procedure.

2. Importance of early attention to hand infections or trauma to the hand in human bites is indicated by the severity, long duration and poor end-results in this type of case. One of the cases required amputation of 2 fingers and one - amputation of the arm because of the development of gas bacillus infection.

3. In spite of increased knowledge of the anatomy of the hand and emphasis upon the proper placement of incisions, there still is a large group of hand infections which present difficult problem in treatment. It cannot be emphasized too strongly that one of the most important factors in the care of hand infections is the careful daily examination of the involved extremity for evidences of progression, areas of tenderness or fluctuation.

4. Application of heat, in the form of hot moist packs, or immersing the extremity in a large basin, elevation, incision, as indicated, are the principles of treatment in the active or acute stage. With subsidence of infection, the institution of active or passive motion and physiotherapy are important to the early restoration of function. It is regrettable that a follow-up study of end-results is not available on these cases.

#### Survey by:

Lois Day  
Gerald Rein  
M. H. Manson

#### IV. ANNOUNCEMENTS

##### BEST WISHES -

HERBERT AUSTIN CARLSON,

Fellow in Surgery, announces his return to private practice, limited General Surgery, in association with his brother, Dr. Lawrence Carlson, at 333 Medical Arts Building, Telephone Geneva 6632.

N E X T    W E E K

##### WELCOME BACK -

ELMER MATTHEW RUSTEN

announces the opening of offices at 220 Medical Arts Building, Telephone Main 6809. Practice limited to Dermatology and Allergic Diseases. Former Fellow in Dermatology; graduate student in Vienna; private practice Oklahoma City, Okla.

##### CHRONIC ULCERATIVE COLITIS

Note: Meeting Wednesday instead of Thursday - Same time - Change for this week only!

##### CORRECTIONS -

Page 41. Part of sentence omitted. "While this includes many small myomata which are probably of no clinical importance, nevertheless it indicates that our findings are much more correct than those reported by other centgenologists."

Page 44. "The Latent" not "The Latest".

Page 42. Misspelling. "Vesalianum"

Page 49. A.D.H. - 1902 to 1912.