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THE PROBLEM OF THE SEPTIC HAND *

BY

R. KENNON, M.D., F.R.C.S.,

HONORARY SURGEON, LIVERPOOL ROYAL INFIRMARY

The problem of the septic hand is of interest to all. The public should be warned not to suck or squeeze minor injuries and to seek medical advice more frequently. Nurses should be forbidden to hand instruments, especially knives and needles, to the operator. The surgeon should always sew towards himself and pull out the thread horizontally, not vertically, if the hand and eye of the assistant are not to be endangered.

Most septic hands arise from puncture wounds. The thorn, needle, and safety-pin, however contaminated as they enter the tissues, are cleansed as they penetrate, by the glove in the case of the surgeon and American artisans who often work in gloves, and by the horny hand of toil; yet beneath the thickened epithelium over the heads of the metacarpal bones, known in the North of England as

FIG. 1.—The horizontal use of a razor blade to remove the epithelium in pricked fingers, thereby extracting thorns and relieving tension.

a "seg," infection may occur, which, if not relieved of tension, macerates and infects the underlying tissues, leading to palmar abscess. Realizing, therefore, that in the superficial layers of the epithelium the penetrating object has left most of its infecting organisms, it is our duty to remove with a razor blade the surface epithelium over the punctured area (Fig. 1), thereby relieving tension during the inflammatory reaction which must follow all trauma, whether infection is present or not. Through this weak spot serum will ooze, carrying to the surface products of the inflammation.

All pricked fingers should be kept dry, or dressed with spirit, and never until infection is established should they be subjected to fomentations, hot or cold. A splint should be applied to prevent the patient squeezing the wound and to ease the pain of muscle spasm.

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If the septic hand is to be prevented more consideration should be given to trivial conditions involving the fingers, especially the nails. The nail is often the source of mechanical irritation which is delaying recovery. Conservative treatment of the nail is essential; if it must be sacrificed then it should be dissected off, and not wrenched from its bed, but, wherever possible, it should be preserved to splint the nail bed and to keep for the soft regenerating nail an area of adequate width to avoid irregular nail formation. When the nail bed requires removal for recurring deformity of the nail the distal half of the phalanx should be excised to relieve tension on sutures.

The crushed finger or subungual haematoma, if associated with fluid beneath the cuticle, should be drained by insertion of a sharp hook, tenotomy knife, or needle beneath the cuticle—the first step in the treatment of paronychia—to avoid maceration and diminish the tendency to infection.

The Congealed Hand or Finger

Imagine the healthy hand or finger plunged into boiling water; the result would be that all avascular structures would undergo aseptic necrosis, the palmar fascia, the dorsal expansion of the fingers, and the deep fascia on the back of the hand suffering most. In 1929, under the title of "Sore Fingers and Such Trivialities,"¹ I published in the *Lancet* an attack on this brutal method of treating injured tissues, and pointed out how it was possible to recognize the severity of previous hot-water treatment by the fact that the nail bed of other fingers, which must be simultaneously plunged into the bowl of hot water, became tender and even developed paronychia; also the annular nature of the swelling so characteristic of the carbolic finger and so different from the irregular edge of a spreading infection. The effect of treatment is dramatic, and many must have observed the immediate improvement that has followed the change to a dry dressing or cold compress: pain ceases and sleep follows.

If the possibility of a congealed finger or hand is recognized and improvement has followed a change in the treatment, it becomes urgently necessary to get these fingers moving to prevent stiffness. With the institution of active movement there may be complete recovery; not infrequently, however, small areas of fascia contract, giving rise to a Dupuytren's contracture, or these areas soften, and at the end of two or three weeks liquefaction of the fascia occurs and abscesses form about the base and dorsum of the finger or below the styloid processes of the radius and ulna, sites which have been subjected to greatest pressure as the finger or hand was held in scalding water.

The Septic Hand

Boils usually form on the dorsal surface of the index and middle fingers at their base, and may involve the opposite hand about the same time, so that soap and the nailbrush become a factor in the causation. When boils are present the finger should be splinted and painted with iodine. If the follicle shows signs of sloughing, denude the area with a razor blade and apply a thick paste of glycerin and magnesium oxide or sulphate. This will save many fingers from an incision. If a localized cellulitis forms round the boil, then an incision stretched widely open by a pair of Spencer Wells or the crucial incision is necessary; but these should never be made under ethyl chloride, otherwise an extensive slough of the avascular fibrous tissue beneath will delay healing and render the graver forms of septic finger possible.

Minor degrees of paronychia have already been considered. If pus develops at the base of the nail, the nail bed should be exposed by lateral incisions and the reflection of the tissues, dissecting off the nail and removing its proximal portion.

Streptococcal Fingers

The pulsating fingers of nurses, dressers, and doctors will always be our gravest problem. Within a few hours the site of infection is pink, slightly swollen, and throbbing, and from it red lines of lymphatic infection spread to the nearest gland. With an injury in the zone of the ulnar nerve distribution the epicondylar gland is enlarged. Infection from the thumb and outer two and a half fingers spreads to the axilla. If, when seen, these lines are broken, a good prognosis may be given. The case must be watched from two equally dangerous foci—the finger and the glands; and absolute rest must be given to both areas. Incisions at the site of the injury have been condemned, yet many patients owe their lives to them. I think a compromise is necessary, and that it can be found in the manoeuvre already described, in which the surface epithelium is removed and the area subsequently dressed with a hypertonic saline dressing or glycerin and magnesia, in order to establish a flow of serum from the wound into the dressing.

For lymphangitis heavy moist towelling, ichthyol ointment, or kaolin paste may be employed, because these are heavy enough to splint the tissues. Bier's treatment has its advocates, but it should only be applied on healthy tissues. On occasion it will be found that with a rigor on the third day after infection, the glands empty themselves into the general circulatory system with a variety of interesting sequelae—bacilluria, albuminuria, haematuria, erythema nodosum, synovitis, or septicaemia. Those who fear the effect of protein shock to the body developing a resistance against infection may withhold the administration of antistreptococcal serum, but it must be administered if toxæmia is intense or rigors have occurred.

Returning to the site of injury, in three or four days pus will have formed, and the case now falls into line with other less fulminating conditions of the fingers and hands. The glands, however, may persist. If they suppurate they should be opened. If they do not suppurate they may remain enlarged for many months, and care should be taken not to remove them under the mistaken diagnosis of tuberculosis. At least three months should elapse after infection before these glands are removed, otherwise local erysipelas, cellulitis, and septicaemia may develop. Many manual workers have bilateral axillary glands, which, without any recognizable injury or infection of the hand, may undergo spontaneous suppuration and involve the patient in a claim for compensation.

Suppuration of Finger or Hand

My interest in septic fingers was stimulated by the remarkable researches of A. B. Kanavel, whose book *Infections of the Hand* should be in the library of all medical practitioners. Most of us will have learned to classify whitlows as the subcuticular, the subcutaneous, the subthecal, and the subperiosteal. A subcuticular whitlow readily yields to treatment if the cuticle is sufficiently removed to prevent maceration. Yet it penetrates to deeper layers in the case of the "seg," and often leads to useless incisions on the back of the hand by those who do not realize the backward drainage of all lymphatics from the fingers and hand, so that, with pus in the palm, the greatest swelling is on the dorsum. The subcutaneous whitlow (or pulp infection) was at one time opened through the centre of the finger, resulting in a fibrous scar which subsequently interfered with delicacy of touch. Then it was attacked by means of the "cod-mouth" incision, which left the finger with a hideous deformity; this method cannot be too severely condemned. Now, I hope, it is only approached from the side. Frequently the operator is

puzzled to make the finger fit the incision, and often he must wish to follow in the line of infection; if such be imperative, again the horizontal line of attack with a lateral incision will help.

The Subthecal and Subperiosteal Whitlow

Difficulty appears to arise in the recognition of tendon sheath infection. We are told that movement of the finger

FIG. 2.—An illustration from Kanavel's book *Infections of the Hand*, showing points of termination or narrowing of tendon sheaths.

is painful and limited, and that on bending the finger backwards if pain is experienced the tendon sheath is involved. But I think careful study of these cases and of the diagrams of tendon sheaths, as revealed by the researches of Kanavel (Fig. 2), will show that where the tendon narrows or terminates, there, in the presence of infection, will be a maximal point of tenderness in the swollen finger or hand (Fig. 3). The tendon sheath must then be opened by a short central incision, if its contents are to be evacuated and the tendon saved. These are also the points at which, by ulceration, the dead tendon will separate as a slough. Full movement is possible with a dead tendon. It must be appreciated that tendons require ten to fourteen days to separate, and that any force used to pull away the tendon before it has completely separated can only spread the infection into the palm and give rise to palmar abscess.

FIG. 3.—Maximum points of tenderness present in tendon sheath infections; of importance in early diagnosis and treatment. They are also the points at which a sloughing tendon separates.

If the infecting agent pierces the bone and still carries organisms with it osteomyelitis may be expected, but osteomyelitis is not present as often as is supposed, especially by those who persist in probing wounds in pulp infection. For bare bone is not dead bone, and we should be very chary of acting upon an x-ray report describ-

ing decalcification of a terminal phalanx and half the adjacent bone. This decalcification will also be seen in the small bones of the hand in palmar infection; it is as natural as the disappearance of fat in all wounds—hence the depressed scar. It is the result of active hyperaemia. When this passes calcium will return to the bones. Amputations should not be performed for such decalcification.

With osteomyelitis of the terminal phalanx spontaneous fracture is common, and if appreciated may then perhaps be prevented by splinting the whole of the forearm. That a sequestrum occasionally forms is not unnatural; it will make its presence felt clinically by a copious discharge of pus, and radiologically it will be seen as a piece of bone still loaded with calcium. It is useless to squeeze the finger or probe it daily in order to obtain this sequestrum; at the end of three weeks it will be loose and may then be picked out.

Palmar Abscess

Palmar abscess may be prevented if the tendon sheaths are opened early, especially those of the thumb and little finger, which, when completely distended, give rise to points of maximal tenderness half an inch above the wrist. With regard to the little finger and common flexor sheath I should like to direct attention to the following words of Kanavel:² "I wish to emphasize that it is upon the ulnar incision that I depend for drainage of the upper end of the bursa," and with him to advocate that this incision be made whenever the bursa has been under tension for forty-eight hours. The terms "radial" and "ulnar" bursa have been applied by this author to the tendon sheaths of the flexor longus pollicis, and the flexor minimi digiti and common flexor expansion respectively. If tension within these sheaths or bursae is great they will burst beneath the palmar fascia.

Kanavel's researches show how the palm may be divided into three spaces: (1) the thenar, stretching from the thumb to the third metacarpal bone; (2) the middle palmar space from the centre of this bone toward the fifth metacarpal bone; and (3) an unimportant hypothenar space in direct contact with the fifth metacarpal bone. From these spaces pus may track forward along lumbrical muscles to the base of the fingers and upwards under the annular ligament to accumulate in front of the pronator quadratus muscle, or, in the case of the thenar abscess, backwards between the adductor transversus and adductor obliquus to the back of the first interosseous space. His incisions should be followed, and his warning observed concerning the motor branch of the median nerve as it crosses the ridge on the trapezium.

Treatment of a Septic Hand

With a working knowledge of Kanavel's incisions the operator will proceed under a general anaesthetic and a tourniquet to establish adequate drainage of the finger or hand, using a breast knife to avoid carrying infection into deeper parts, as may happen with a pointed knife employed in the dissecting position. No drainage material should be used across the fingers; but for palmar and forearm abscesses it should be rubber dam or corrugated rubber, never gauze, which can only plug a wound and prevent the escape of pus.

The dressing immediately after operation and throughout the greater part of healing should be a moist one, and it is here that hot fomentations become the most important of all dressings—not that it is necessary to apply them at anything greater than body temperature. By its dead weight the moist dressing splints the tissues; moist gauze absorbs blood and serum more quickly than dry gauze, and it can be changed without damaging the tissues. All dressings should be moistened to remove them without haemorrhage, which reopens tissues to

further infection. A dressing may be kept moist by the further addition of saline, etc., every two hours during the day; this will disturb the parts less than the hourly or two-hourly fomentations of the past.

Oiled silk, etc., should be used to protect the surrounding clothes from being soaked, not to prevent evaporation from the dressing. It is sometimes used so closely to the wound that the pink dye of boric lint can be seen upon the skin. Such a dressing is physically wrong; if particles of dye are passing from the dressing into the wound, then poisons cannot leave the wound.

The idea that antiseptics can kill organisms in human tissue without destroying the tissues themselves dies hard; any antiseptic we may employ should be used to keep the dressings from becoming in themselves a hotbed of bacterial activity, as seen in a poultice.

The Stiff Finger

Every effort should be made to prevent any stiffness developing in the diseased or adjacent fingers; this can only be done by very careful timing of the removal of the splint and the institution of voluntary movement in the adjacent fingers. The sooner the swelling of the fingers is dispersed the better for the patient. In the beginning all fingers should be kept straight, but after three or four weeks, when it becomes obvious that stiffness is likely to follow, they should be allowed to become slightly flexed at all joints. It is difficult to apply extension to the diseased finger, but there is no reason why adjacent fingers threatened with stiffness should not be extended and their joint surfaces kept separate by means of a splint, taking its bearing from the front of the arm.

Imbert³ protests against the low assessment sometimes given for ankylosis at the metacarpo-phalangeal joint, the interphalangeal joints being free. For the right thumb he allows 15 per cent., and 10 per cent. for the left; 12 per cent. for the index finger, and 7 per cent. for the others, slightly less on the left hand. In spite of the grave possibility of a finger showing ankylosis or limited movement, I think it is our duty to allow three months to elapse after healing has been completed before urging an amputation. During this time a willing patient may have learned to adapt himself to his disability, so that he may be quite unwilling to face an amputation. A patient can play the piano with both interphalangeal joints ankylosed. During this three months recovery, often surprisingly good, will be helped by stretching and rocking the fingers several times a day after they have been vascularized by radiant heat or immersion in warm water, paraffin, etc., strict attention being paid to the acquired Dupuytren's contraction, due to shortening of the palmar fascia.

Amputations

Apart from suppurative arthritis or loss of the tendon, amputations should not take place at an early date. If the tendon is not loose at the time of operation it should not be cut short, since by its retraction it will infect the palm. It should be brought to the surface between the loose stitches necessary in such cases, and in a few days it will separate naturally. Three months after healing it will be possible to discuss with the patient how much of a finger it will be best to sacrifice for his particular type of work, pleasure, and social status. All amputations of the fingers should be as conservative as possible, and leave a patient with a scar free from pressure and neuromata.

Knowing how well patients in sheltered occupations can manage with considerable finger loss, as, for instance, after the roller or calender accidents in laundries, it is necessary to remind ourselves that the assessments are high, and reach for the loss of the terminal phalanx of the thumb 15 per cent. for the right hand, 10 per cent. for the left,

and about 5 per cent. for the other fingers. Amputations at the proximal interphalangeal joint are best performed by a steam hammer, for then the balance between the flexors and the extensors is maintained from the outset by these tissues being crushed into the bone. Surgically we do not obtain such good results, and a lagging finger stump, especially of the middle finger, is a serious disability demanding re-amputation.

In performing amputations at the proximal interphalangeal joint a towel clip should be forced through the

FIG. 4.—Use for a towel clip to prevent retraction of the flexor tendon during amputation of a finger at the interphalangeal joint.

flexor and extensor tendons down to the bone with the finger held in a position of rest—that is, 45 degrees flexed at the metacarpo-interphalangeal joint. This will prevent retraction of the flexor tendon during the amputation, and enable the operator to suture the tendons over the bone end in a correctly balanced posture (Fig. 4). The advantage of a successful proximal interphalangeal amputation to the patient is great, for with the hand at rest he can successfully hide his deformity.

To the writers of textbooks, especially those dealing with practical surgery, I would appeal for more careful illustrations of finger amputations (Fig. 5). The incision should start at the metacarpo-phalangeal joint, which is half an inch above the web of the finger, and not, as so

FIG. 5.—Incisions for amputation of a finger at the metacarpo-phalangeal joint, by the Racquet method.

often illustrated, somewhere near the base of the metacarpal bone. It should be carried in the axis of the finger as far as the middle of the proximal phalanx; it may, with advantage, be placed nearer the mid-line of the hand in the case of the index or little fingers. From the middle of the phalanx the incision should pass horizontally round the finger almost at right angles to the vertical incision, and never so obliquely that it skirts the web, and would, in the case of the index finger, thus give rise to difficulty in covering the bone end, and, on occasion, to the serious mistake of removing the head of the first metacarpal bone, which ruins the grip.

Summary

The problem of the septic hand involves careful consideration of the mechanical, chemical, and thermal factors in treatment, which may delay healing of a non-infected wound. Adequate incisions under a tourniquet and general anaesthetic are necessary. Uninfected wounds should be splinted and kept dry; infected wounds require moist dressings. No drainage material should be used on the fingers. Stiffness may be minimized by careful judgement in each case of the time when movement or finger extension may be allowed. Amputations are necessary in only 2 per cent. of cases, and, wherever possible, should be designed to suit the work and social status of the patient.

My thanks are due to Mr. Douglas Kidd for the drawings he has made.

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TROPICAL SPRUE AND ITS MODERN TREATMENT*

BY

N. HAMILTON FAIRLEY, M.D., D.Sc., F.R.C.P.

ASSISTANT PHYSICIAN AND DIRECTOR OF PATHOLOGY, HOSPITAL FOR TROPICAL DISEASES, LONDON

Tropical sprue in its typical form is characterized by apyrexial morning diarrhoea with pale, gaseous, bulky, fatty stools, sore tongue, buccal aphthae, intestinal flatulence, megalocytic anaemia, marked wasting, and profound asthenia associated with a low blood pressure. The abdomen is distended, and its thinned parietal wall but scantily covers the coils of gas-distended bowel beneath. Definite skin pigmentation, cramp, tetany, and oedema may be superadded. At times the stools do not conform to the classical type, in other cases intestinal symptoms, characterized by fatty diarrhoea and abnormal carbohydrate fermentation, may occur unaccompanied by anaemia, while occasionally—especially in relapses following respiratory infections—severe megalocytic anaemia may develop in the absence of intestinal features. I have never observed subacute combined degeneration in sprue, though neuritic manifestations are common enough.

The syndrome itself is explicable in terms of a dysfunction of the gastro-intestine, characterized by defective gastric secretion and malabsorption of fat, glucose, calcium—and probably the p.a. factor—in the small bowel. Three cases recently examined within one hour of death by Mackie and the writer failed, as in Thaysen's case (1931), to reveal specific atrophy or inflammatory lesions in the gastro-intestine, and we now regard the intestinal and visceral atrophy, the small heart with its characteristic brown atrophy, and the megaloblastic red marrow as secondary to a gastro-intestinal derangement, the essential cause of which is still under investigation. The absence of a demonstrable parasitic agent such as a virus, bacterium, or fungus, the apyrexial course of the illness, and the essentially non-inflammatory nature of the tissue changes are against an infective origin.

Aetiological Considerations

Sprue generally affects adult Europeans or those of mixed European stock after some years of residence in an endemic area: it may directly follow hill diarrhoea, as emphasized by Rogers (1921), and is not infrequently preceded by a history of dysentery or chronic malaria necessitating prolonged quinine administration. Except in Porto Rico native populations are rarely affected, while damp coastal climates favour its development. Peculiar features are its rarity in Africa and its occasional onset in tropical patients after many years' residence in Europe.

Various theories regarding its causation have been put forward. Ashford (1915) regarded it as a moniliasis of the digestive tract, and later considered the yeast infection to be engrafted on an unbalanced dietary. Elders (1919) regarded it as a primary deficiency disease due to lack of vitamin A and B and amino-acids. Scott (1923) postulated parathyroid deficiency as the aetiological factor. Strauss and Castle (1932) suggested that pernicious anaemia, sprue, tropical macrocytic anaemia, and coeliac disease were conditional deficiencies caused by a lack of a specific reaction between the extrinsic factor taken in the food and the intrinsic factor secreted by the gastric juice; they regarded vitamin B₁₂ as the source of extrinsic factor.

My own view is that sprue arises as a functional breakdown in the gastro-intestine, and that any factor or factors depressing its secretory or absorptive function will predispose. It is known, for example, that certain tropical infections such as malaria and dysentery may depress

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