

A PROSPECTIVE STUDY OF ACUTE AEROBIC HAND INFECTIONS IN A RURAL AND URBAN HOSPITAL IN ZAMBIA.

PROJECT SUBMITTED AS PARTIAL FULFILMENT FOR THE AWARD
OF MASTER OF MEDICINE (SURGERY) OF THE UNIVERSITY OF
ZAMBIA.

BY: DR. SYED ISHRAT HUSAIN. B. Sc. HB.MBChB.
DEPARTMENT OF SURGERY, UNIVERSITY TEACHING
HOSPITAL, LUSAKA, ZAMBIA.

SUPERVISOR: PROFESSOR KRIKOR ERZINGATSIAN
FRCSI. HEAD OF DEPARTMENT OF
SURGERY UNIVERSITY TEACHING
HOSPITAL, LUSAKA ZAMBIA.

257351

THESIS
HUS
1997

2. CERTIFICATION

This is to certify that this dissertation is now ready for examination.

DATE:

10/3/98

SIGNATURE OF SUPERVISOR:



3. DECLARATION

I, DR. SYED ISHRAT HUSAIN, do hereby declare that this thesis has not previously been written or presented for any Diploma or Degree by any other person at any other University.

DATE:

7/2/98

SIGNATURE

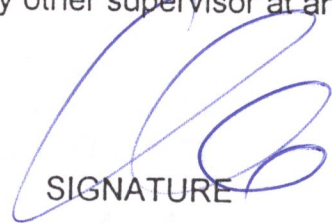


I, Professor KRIKOR ERZINGATSIAN, do hereby declare that this thesis has not previously been supervised by me or any other supervisor at any other University.

DATE:

10/3/98

SIGNATURE



APPROVAL

APPROVAL

This dissertation of **Dr. Syed Ishrat Husain** is approved as fulfilling part of the requirements for the award of the degree of Master of Medicine in Surgery by the University of Zambia.

Subject to examiner's report

Signature:

Date:

[Handwritten signature]
[Handwritten signature]
[Handwritten signature]

31-08-97

4-9-97

9/9/97

SIGNATURE OF EXAMINER:

4. APPROVAL.

This dissertation of Dr. SYED ISHRAT HUSAIN is approved in partial fulfilment of the requirements for the award of Master of Medicine in Surgery by the University of Zambia.

DATE:

SIGNATURE OF EXAMINER:

DATE:

SIGNATURE OF EXAMINER:

DATE:

SIGNATURE OF EXAMINER:

DATE:

SIGNATURE OF EXAMINER:

5. ABSTRACT:

The hand is a specialised tool of the body that has a very high representation in the central nervous system for both sensory and motor function and any disability of it affects the work and general well being of the patient extensively. Impairment of function may therefore have psychological, social and economic consequences.

This study was aimed at finding out the aetiological organisms involved in hand infections, the site, the relationship to profession and associated morbidity.

Over 70% of aerobic infections were found to be due to Staphylococcus aureus. 10% were to Beta - Haemolytic Streptococci. Staphylococcus aureus was commonly resistant to Tetracycline, Ampicillin and Penicillin at U.T.H. in Lusaka, whereas it was sensitive to the above in the rural hospital in Katete..

Over 60% of the patients could not recall any injury prior to the infection. The average stay in hospital after incision and drainage was one day. But loss of working days averaged fourteen from time of infection to commencement of work.

Three cases in Katete showed marked disability four weeks after treatment as they had developed frozen hands. These three cases had extensive infection involving multiple spaces of the hand and they all presented two weeks after the first symptoms.

Thus, early presentation to hospital with early incision and drainage and early mobilisation and elevation enhanced recovery. No mortalities were recorded in this series.

6. INTRODUCTION.

Hand infections are common infections found in general hospitals world-wide. Sixty percent of the time no injurious agent is remembered by the patient. Nevertheless, the problem would be expected to occur in manual workers who labour as young active farmers in rural areas of Zambia and the industrial areas of Urban Lusaka. Because of the proximity of hospitals in the city, patients with hand infections tend to come to hospital earlier, thus the results of treatment should be better.

Hand morbidity means loss of earnings for most affected people. Moreover, a frozen hand is a serious disability. In mild infections of the hand the loss of work time is considerable.

In order to offer timely and effective treatment it is necessary to know the aetiological agent responsible for hand infections in our environment and what antibiotic to use. The site is another important consideration which determines surgical management and subsequent outcome.

To the best knowledge of the investigator such considerations as the aforementioned have not been investigated and published in Zambia. This project addresses the issue.

7. LITERATURE REVIEW.

150 patients with hand infections were seen during a six month period at Khartoum Teaching Hospital, in Sudan, (Eseldeen et al, 1992). The disease was found to be common among young males, manual and industrial workers (male to female ratio - 2:1). Common types were Paronychia - 41%, volar space Infection - 30.6% and subcutaneous infections - 20%. Thirty percent of the patients needed hospital admission including all the diabetics(N=15). Two had serious complications resulting in above-elbow amputations. The first was a diabetic with spreading cellulitis and the second was a mentally retarded patient with gas gangrene. Initial empirical antibiotic therapy was prescribed in 89% of the patients and later modified after sensitivity results. 90% needed surgical drainage. Bacterial examination showed Staphylococcus aureus in 51.% of cultures and it was resistant to penicillin in 77%. Apart from two deaths, the rest had a satisfactory outcome.

In another paper from South Africa, Martin and Singer, 1976, on 1000 hand infections, they described the site of hand infections and compared it to other published series (Table 1).

TABLE 1

SPACE	PERCENTAGE
Distal Pulp Space	33%
Paronychia	33%
Middle Pulp Space	6%
Proximal Pulp Space	9%
Tendon Sheath	0.5%
Dorsum of Finger	6%
Web Space	6.5%
Subcutaneous Palmar Space	3%
Palmar Spaces	0.5%
Dorsum of the hand	2.5%

The bacterial organism responsible for the vast majority of infections (80%) was reported as being due to Staphylococcus aureus. Haemolytic Streptococcus was responsible for 5% to 10% of infections. The mode of infection was most commonly by inoculation e.g. pinkprick. Only 50% could recall specific injury in the above study.

According to David et al, 1993, who have done a review of published series in America, the incidence of types of hand infections is shown Table 2 below.

TABLE 2

INFECTION	INCIDENCE
Cellulitis	35%
Paronychia	35%
Felon	15%
Tenosynovitis	10%
Deep Space Abscess	2%
Septic Arthritis	2%
Osteomyelitis	1%

They also identified the aetiological factor as being trauma in 60%, human bites in 25% to 30%, hypodermic needle use in drug abuse in 10% to 15% and animal bites in 5% to 10%. According to their series organisms in hand infections are as shown in table 3 below.

TABLE 3.

TYPE	ORGANISM	PERCENTAGE OF HAND INFECTIONS
1. Aerobes		65%
a. Gram Positive	Staphylococcus Aureus	35%
	Alpha Haemolytic Streptococcus	29%
	Group A Beta Haemolytic Streptococcus	23%
	Staphylococcus Epidermidis	18%
b. Gram Negative	Pure Gram Negative	5%
	Klebsiella pneumoniae	7%
	Enterobacter cloacae	7%
	Escherichia Coli	2%
	Proteus Mirabilis	2%
2. Anaerobes		30%

The investigator has not been able to find such data from the regional literature.

8. **OBJECTIVE OF STUDY.**

The objective of this research is to study the site and the aetiological aerobic organisms found in hand infections and to determine the sensitivity pattern of the organisms in a rural and urban hospital in Zambia.

9. RATIONALE.

Hand infections cause much morbidity and loss of working hours. Delay and inappropriate management increases morbidity and long term disability. An accurate knowledge of aetiological and occupational factors, the type of bacteria involved and sensitivity patterns and the common sites involved in hand infections can offer the patients optimum management. To date such information is not available in Zambia.

10. PATIENTS AND METHODS.

This prospective study was carried out beginning at the Saint Francis Hospital in rural Katete between 4th November, 1995, and 30th April, 1996. Any patient who came in with a hand infection in the out patient clinic was referred to the author.

A proforma was filled out for every patient in the out patient clinic, indicating the name, age, sex, residential address, occupation, circumstances of injury, duration of infection prior to presentation to hospital and the site of the hand involved. Pus aspirates were then collected either in the clinic or in theatre prior to drainage. Sterility at the time of aspiration was maintained using spirit swabs. The specimens were taken personally by the author to the laboratory with minimum delay as the laboratory was open 24 hours. Microscopy was done by the laboratory technician. The aspirates were inoculated on two blood agar plates and MacConkey agar plates. The plates were examined for growth and identification of microbes after 24 and 48 hours.

The sensitivity was then done and included ampicillin, tetracycline, penicillin, chloramphenicol, gentamicin and co-trimoxazole.

The patients were taken to theatre for incision and drainage. They were then admitted to the ward and commenced on ampicillin. The wounds had saline soaks placed on them and the hand was elevated on a pillow placed upon the chest. Panadol or Aspirin were given as analgesia. The majority of patients were kept overnight in the ward. Physiotherapy was commenced on every patient as soon as the patient had pain relief and this basically involved making a fist with the hand, flexing and extending the fingers. The patients were followed up weekly for 4 weeks and the final functional state of the hand noted.

Only 30 patients with hand infections presented at Katete throughout the six month period. Katete serves a catchment population of approximately 300000 people. The hospital has a surgical work load of approximately 40 patients per week. The incidence of hand infections is 2%.

The study was then continued in urban Lusaka at the University Teaching Hospital from 1st June, 1996 to 30th November, 1996. The average daily attendance at the surgical out patient department is 40 and out of this the average incidence of hand infections is approximately 4%. Lusaka serves a catchment population of approximately 1.8 million people.

The study was done in the casualty surgical male and female wards. The hospital has 5 surgical units that are on call from Monday to Friday.

This study took the admissions of hand infections by two surgical units. The author personally admitted patients with hand infections and the same proforma as that of Katete was filled up for each patient. Pus aspirates were then taken and sent to the micro biology laboratory where microscopy was performed by the laboratory technicians. Cultures were then done on blood and MacConkey agars. Sensitivity patterns were then done and included ampicillin, penicillin, gentamicin, cloxacillin, tetracycline and Erythromycin.

They were then taken to theatre for incision and drainage and most were kept overnight. They were put on cloxacillin, and aspirin or panadol. Saline soaks were placed on the wounds, and the hand was elevated by placing it over a pillow on the chest and the patient was advised on specific physiotherapy. They were then followed up weekly by the author for four weeks in the surgical clinics and the final functional state of the hand noted. The duration from time of disability to return to work was also noted.

During the six months period 70 patients with hand infections were collected from these two surgical units.

The study therefore collected a total of 100 cases over a period of one year. Differences in the organisms isolated in Katete and Lusaka and their sensitivity patterns were noted.

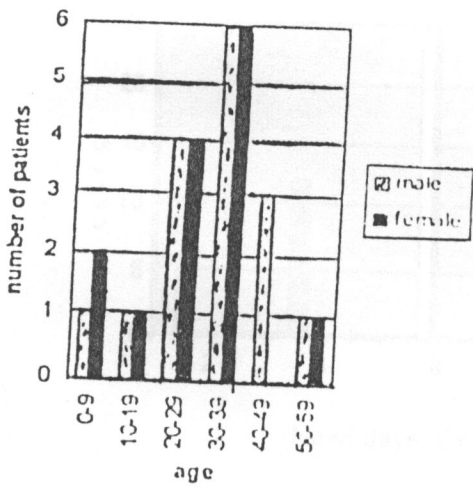
11. RESULTS

The study included 100 patients with purulent hand infections in both Katete and Lusaka. There were 63 males and 37 females, giving a ratio of 1.8 -1.

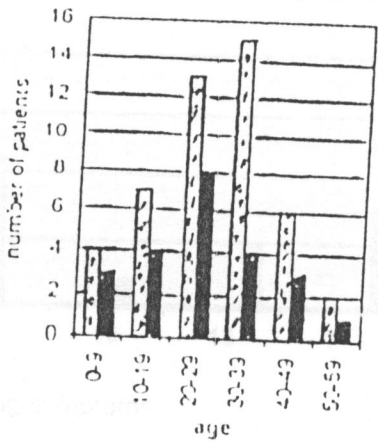
(A) Age and Sex

Age and Sex distribution is shown in Table 4(a) and (b), for Katete and Lusaka respectively.

KATETE (a)



LUSAKA(b)



In Katete the ratio of Male to Female was nearly 1:1

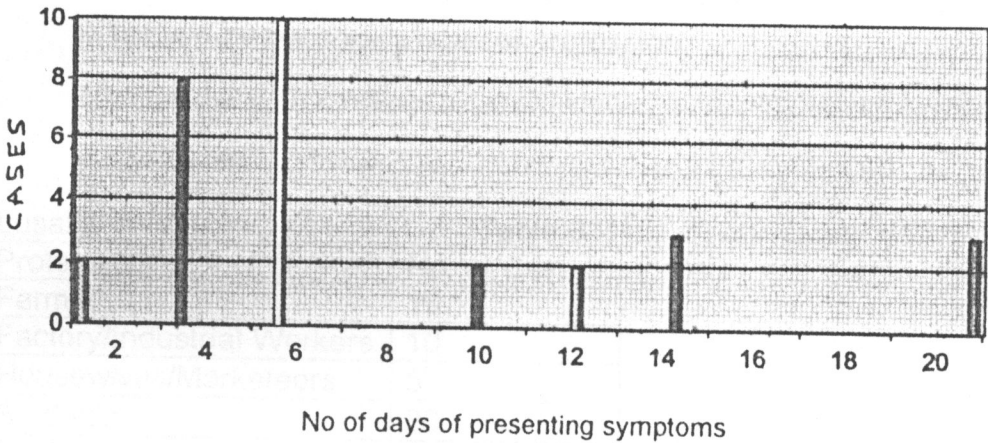
In Lusaka the ratio of Male to Female was 2:1

(B) Presenting Symptoms.

The duration of symptoms ranged from two days to twenty one days. All patients had pain and swelling of the area of hand involved. The average duration was seven days. Over two thirds of all patients presented during the first week but only 8% patients presented during first 48 hours of symptoms. Table 5 shows the duration of presenting symptoms.

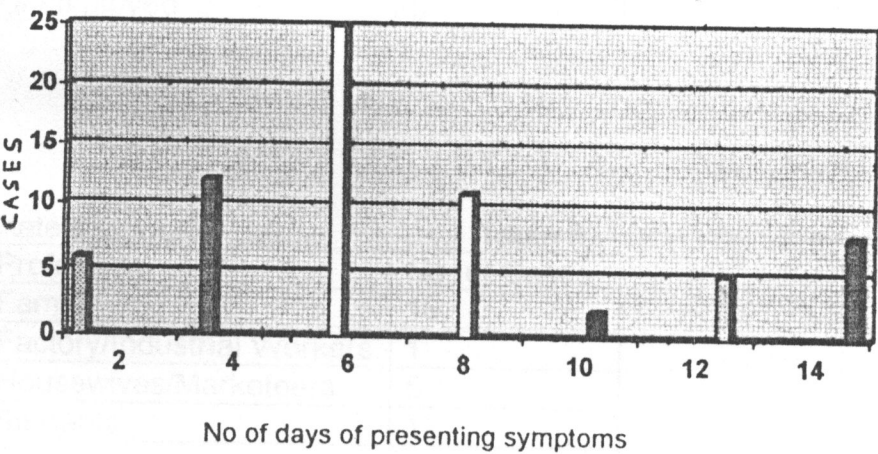
KATETE

Table 5



LUSAKA

Table 5



The three patients that presented with nearly 3 weeks history of symptoms were the patients that had developed frozen hands four weeks after treatment.

(C) Profession

The profession of the patients included farmers, businessmen, students, industrial workers, drivers, clerks, radiographer and medical laboratory technician.

Table 6 below shows table of profession.

Lusaka	Table 6
Profession	No. of Cases
Farmer	19
Factory/Industrial Workers	10
Housewives/Marketeers	5
Students	20
Drivers	6
Paramedical	2
House Servants	3
Unemployed	5

Katete	Table 6
Profession	No. of Cases
Farmer	16
Factory/Industrial Workers	1
Housewives/Marketeers	5
Students	1
Drivers	0
Paramedical	1
House Servants	3
Unemployed	3

16 out of the 35 farmers were from Katete.

(D). The Circumstances of Injury

More than 60% of the patients could not recall any injury. Table 7 shows the circumstances of injury and number of cases.

Out of the three snake bites, 2 were from Katete and one of the snake bites presented three weeks late and developed a frozen hand. Objects piercing the hand included shrapnels from machining tools, fish spines or bones ,thorns from plants during farming and needles for sewing.

Lusaka Table 7

Circumstances of Injury	No. of Cases
Unknown	41
Objects piercing hand	15
Human bite	4
Snake bite	1
Biting own nail	4
Cutting oneself	5

Katete Table 7

Circumstances of Injury	No. of Cases
Unknown	20
Objects piercing hand	5
Human bite	1
Snake bite	2
Biting own nail	2
Cutting oneself	0

(E) Organisms Isolated.

Table 8 below shows the organisms that were isolated by cultures.

Out of the total 15 cultures with no growth, 8 were from Katete

Lusaka

Table 8

Organisms	No: of Cases
Staphylococcus Aureus	53
Beta - Haemolytic Streptococcus	5
Proteus Mirabilis	3
Pseudomonas	2
Escherichia Coli	0
Salmonella	0
Klebsiella	0
No Growth	7

Katete

Table 8

Organisms	No: of Cases
Staphylococcus Aureus	18
Beta - Haemolytic Streptococcus	4
Proteus Mirabilis	0
Pseudomonas	0
Escherichia Coli	0
Salmonella	0
Klebsiella	0
No Growth	8

(F) **Sensitivity.**

The majority of Staphylococcus aureus in Katete were sensitive to ampicillin, gentamicin and tetracycline, whereas in Lusaka, in over 90% of the cases the organism was sensitive to chloramphenicol, cloxacillin, erythromycin and cotrimoxazole. In Katete Staphylococcus aureus was resistant to Chloramphenicol and cotrimoxazole in over 85% of the cases. In Lusaka Staphylococcus aureus was resistant to tetracycline, ampicillin and penicillin. The Beta Haemolytic Streptococcus was commonly sensitive to penicillin.

(G). The Anatomical Spaces.

Table 9 below shows the anatomical spaces that were involved in my study.

The majority of cases were in the distal pulp space, paronychia and web spaces. The three that had mixed space involvement developed complications. 59% of the cases involved the fingers.

Lusaka

Table 9

Space	No: of Cases
Mixed	0
Dorsum of Finger	3
Palmar Space	3
Dorsum of Hand	6
Middle volar Space	8
Paronychia	13
Web Space	15
Distal Volar Space	22

Katete

Table 9

Space	No: of Cases
Dorsum of Finger	0
Palmar Space	1
Dorsum of Hand	2
Middle volar Space	3
Mixed	3
Distal Volar Space	5
Paronychia	8
Web Space	8

(H) Complications.

Only three cases had the complication of a frozen hand. They all presented 3 weeks after the first symptoms of pain and swelling in hand. The infection involved the web spaces, dorsum and palmar spaces.

They were unable to make a good fist 4 weeks after incision and drainage and therefore unable to utilise that hand for any effective work.

12. DISCUSSION.

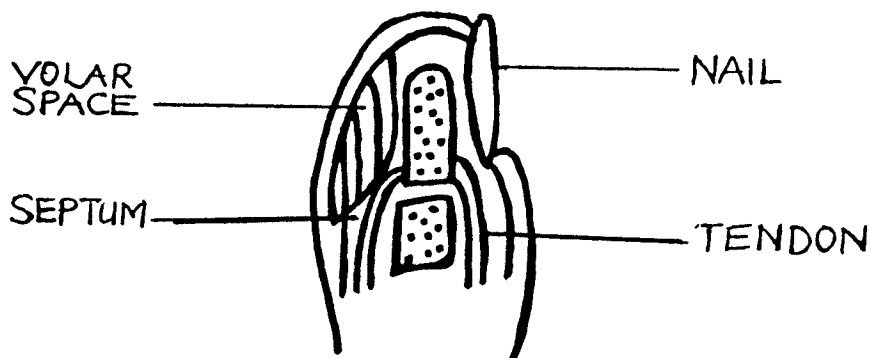
To understand the different spaces of the hand it is important to know the anatomy of the hand. The hands reaction to infection is dominated by anatomic considerations. The hand is divided into compartments by fascial planes that provide numerous potential paths along which pus may track.

Anatomical Consideration.

(a). The Distal Volar Space

The distal volar space is at the distal segment of the digit. It is closed proximally by fusion of the dermis of the distal flexion crease with deep fascia, which in turn is attached to the periosteum just distal to the insertion of the long flexor tendon, and is filled with compact fat, feebly partitioned by fibrous septa. When infected, tight fixation of the dermis to the fascia and the fascia to the bone, interferes with swelling of the parts concerned that the tension within the space becomes extreme. sometimes not only does necrosis of the soft tissue occur, but thrombosis of the vessels crossing the space leads to necrosis of the terminal phalanx and osteopaenia and osteomyelitis of the underlying bone.

Figure 1 below shows diagram of the above space.

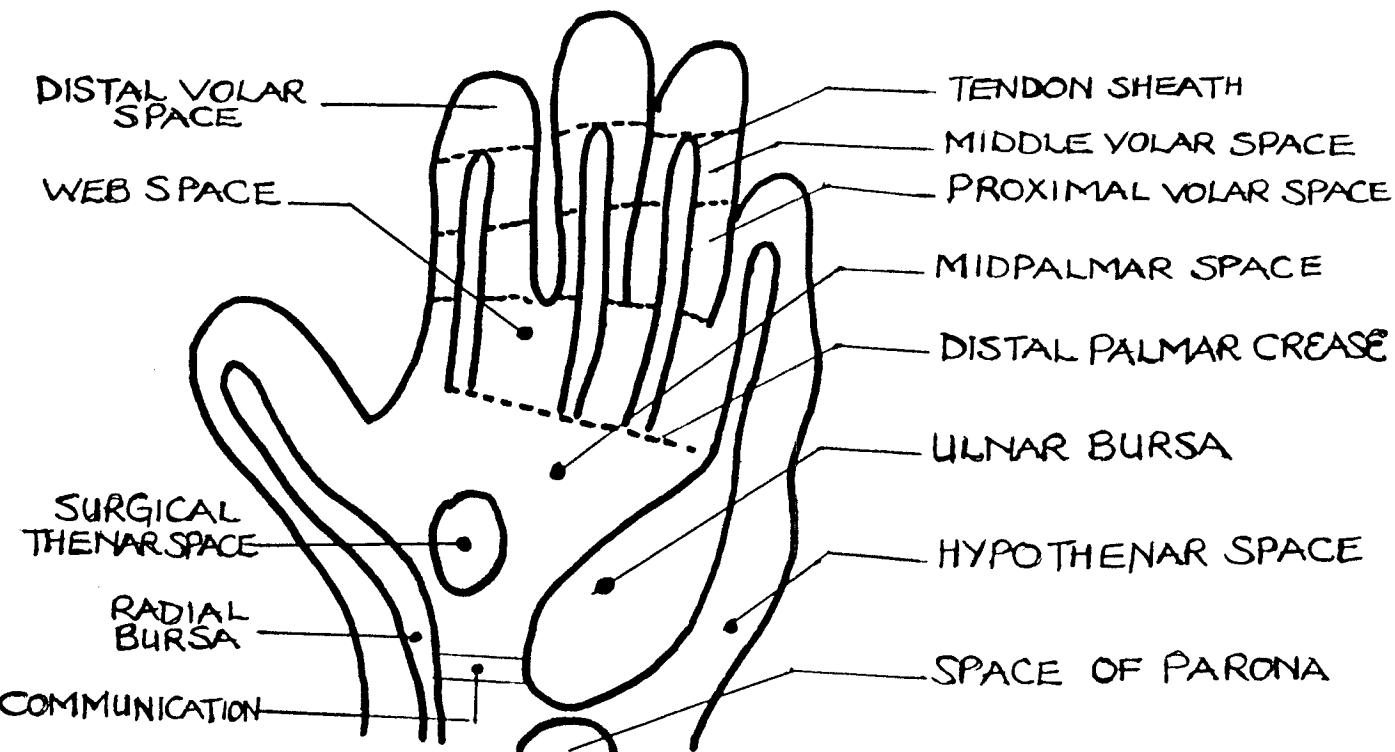


(b). The Middle Volar Space.

The middle volar space has pulp fat which is less in extent and surrounds the flexor digitorum profundus tendon enveloped by its synovial sheath in its distal two-thirds. At the base there is found, in addition, the insertion of flexor digitorum sublimis. On the dorsum, the subcutaneous fatty layer is thin and overlying the inter phalangeal and meta carpo phalangeal joints, it is so thin that the skin is closely related to the extensor tendon complex, which in turn is closely connected with the joint capsule.

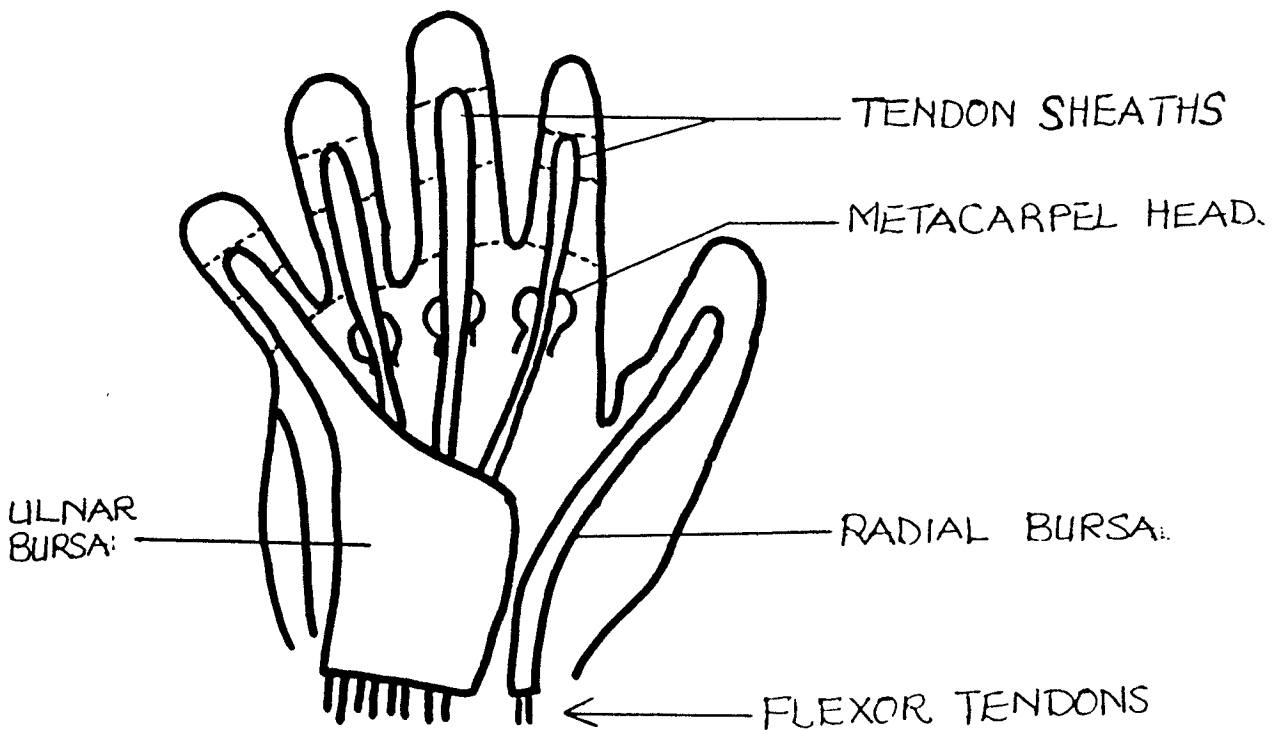
(c). The Proximal Volar Space.

The proximal volar space has anatomical features which are similar to the middle volar space, except that the profundus tendon is closely embraced by the sublimis as it passes through to the terminal phalanx where it is inserted. Infection from proximal volar space can spread to the web spaces. Figure 2 below shows the anatomical compartments of the hand.



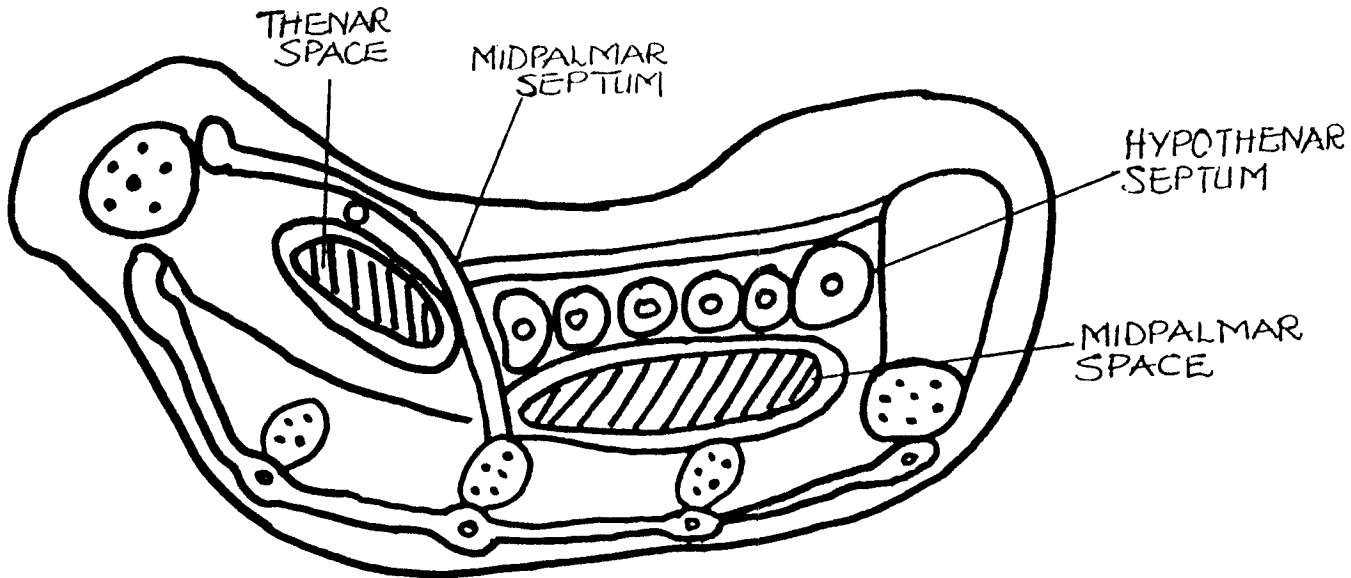
(d). The Flexor Synovial Sheath.

The flexor synovial sheath is a mesothelial investing structure with a closed space between the visceral layer adherent to the flexor tendon and the parietal layer. The sheath extends from the proximal end of the proximal fibrous flexor sheath to the level of the distal inter phalangeal joint. The sheath of the thumb is contiguous with the radial bursa and the sheath of the small finger is contiguous with the ulnar bursa. The radial and ulnar bursae extend proximal to the carpal tunnel. Figure 3 below shows the flexor synovial sheaths.



(e) The Deep Spaces.

Figure 4 below shows the deep spaces of the hand.



The deep spaces of the hand include the dorsal sub-aponeurotic, thenar, mid palmar, Perona's quadrilateral space and the inter digital sub fascial web spaces. The dorsal sub-aponeurotic space is contained by the extensor tendons and fascia dorsally and the metacarpals and inter- osseous muscles on the palmar aspect.

The volar aspect of the palmar spaces is formed by the strong palmar fascia and the dorsal aspect consists of the metacarpals shafts and inter-ossei which are covered by a layer of fascia. The deep palmar spaces lie deep to the contents of the palm vessels, nerves, flexor tendon and lumbrical muscles. Two septa pass vertically from palmar fascia to the skin of the hand, one septum is attached to the middle of the third metacarpel and one is attached to the shaft of the fifth metacarpal. Between the two septa lies the mid palmar space. The hypothenar space lies on the ulnar side of the mid palmar space and contains the hypothenar muscles. The anatomical thenar space lies on the radial side of the mid palmar space and contains the thenar muscles. The surgical thenar space is also known as the adductor space. It includes the anatomical thenar space and should perhaps be better known as the thumb web space. Infections confined to the anatomical space are rare.

The deep palmar space is bordered dorsally by the long and ring finger metacarpals and the second and third palmar inter-osseous muscles, on the palmar side by the flexor tendons and lumbricals, radially by the mid palmar septum, and ulnarly by the hypothenar muscles.

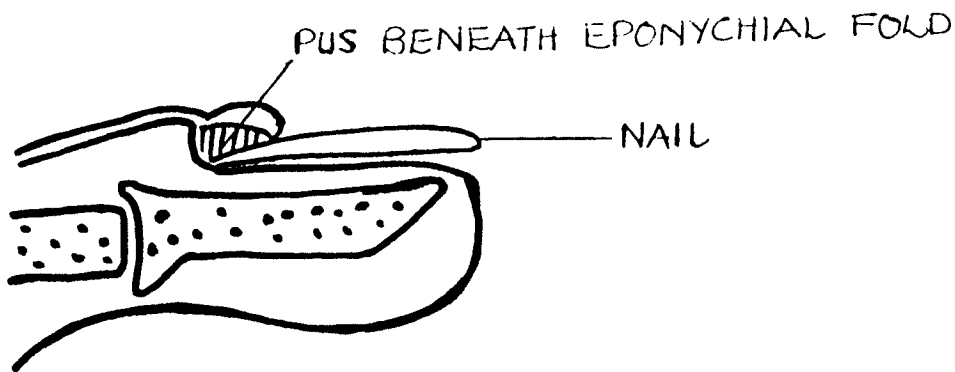
The web spaces are areas of loose connective tissue in the spaces between the fingers. These spaces extend distally into the subcutaneous tissue on either side of the digits.

Perona's space is a space between the pronator quadratus muscle and the deep flexor tendons in the forearm, about five centimetres above the wrist, in continuity with the tendon sheaths and the mid palmar space.

Anatomical Spaces and Infections.

(a). Paronychia.

Figure 5 below shows the sagittal section of a digital tip.



Paronychia is a common hand infection that involves the soft tissue nail fold around the fingernail and produces erythema, swelling and throbbing pain. It may extend into the proximal nail fold as eponychia and around to the opposite nail fold to form a "run around abscess."

(b). Felon.

A felon is a closed space subcutaneous infection in the pulp space of the distal phalanx of a digit. Characteristically felons produce throbbing pain, swelling, erythema and exquisite tenderness in the digital pulp area.

(c) **Volar Space Infections**

Infection of the terminal pulp space is common. Dull pain and swelling over the affected pulp are the first symptoms. Infection of the middle volar pulp space causes pain and swelling in the pulp space and the finger is held in semiflexion. Infection of the proximal volar pulp space causes tender induration in this segment of the digit and frequently a web space becomes involved too.

(d) **Flexor Tenosynovitis**

Acute suppurative tenosynovitis is often caused by a prick in one of the digital flexion creases-here the sheath is remarkably near the surface. Typically the finger is held in a flexed position. There is symmetrical swelling of the whole finger in late cases. Exquisite pain is produced by the slightest attempt at extension of the infected digit or digits-commonly the index, long or ring fingers. In infection of volar pulp spaces extension may produce pain but never so severe.

(e) **Deep Space Infections**

The surgical thenar space infection gives rise to typical ballooning of the thenar eminence including the thumb web space, which is quite characteristic. Flexion of the distal phalanx may occur rarely, but it lacks the resistance to extension that is present in tenosynovitis of the flexor pollicis longus.

The deep palmar abscess or mid palmar space infection causes swelling of the back of the hand. Obliteration of the concavity of the palm with even slight bulging thereof is characteristic. By reason of swelling, a very great enlargement of the hand results.

Signs of the involvement of the ulnar bursa include flexion of the little finger, fullness of the palm, fullness immediately proximal to the flexor retinaculum on the ulnar side.

Signs of involvement of the radial bursa include flexion of the thumb, tenderness of the flexor pollicis longus sheath, and swelling just proximal to the flexor retinaculum on the radial side.

Infection of the dorsal subcutaneous space of the hand is fairly common, as also is that of the corresponding space in the proximal segment of the digits: that of the dorsal subaponeurotic space is rare, except as secondary phenomenon following spread of infection from the palm. If swelling of the dorsum accompanied by tenderness, induration and perhaps redness, is present, a diagnosis of dorsal space infection can be made. The dorsum of the hand is the main venous and lymphatic drainage site of the palmar structures. It is therefore essential to distinguish between primary and secondary involvement of the dorsum of the hand.

Web space infections cause swelling and pain in the web space and distal palm and abduction of the digits on either of the space. There is gross oedema of the back of the hand and although web space infection can be strongly suspected from the location of the tenderness, it is often difficult to rule out tenosynovitis.

In the pre antibiotic era, even the most trivial hand injuries frequently led to devastating loss of function, loss of limb and sometimes even loss of life as a result of infection. With the advent of antibiotic therapy for hand infections in the 1940's the incidence of devastating complications of hand infections dramatically dropped. In the early 1900's Alan. B. Kanavel, an anatomist and surgeon, introduced a systematic anatomic approach to the diagnosis and treatment of hand infections with the publication of his monograph. This landmark work delineated the basic principles for the treatment of hand infections, and most of these principles are still used today.

The importance of a normally functioning hand needs no emphasis and any delay in healing is serious. Delayed healing implies the formation of excessive granulations and of mature fibrous tissue which impairs either tactile or prehensile functions of the hand.

Clinical Considerations.

During the six months period in Katete 30 patients with a diagnosis of acute purulent infection of the hand were admitted to the surgical wards. In Lusaka during the six months period 70 patients were admitted to the surgical wards by two out of the five admitting firms during on-call days, i.e. two days per week. Eseldeen et al, 1992, collected 150 patients during a six month period. Martin and Singer 1976, collected 1000 cases over a period of one year.

In my study the age range was between 5 and 59 years of age, with an average of 30. The average age in the Eseldeen et al 1992, study was 35. The majority of patients were less than 40 years of age. This is the age group that is involved in manual labour, such as farming and working in factories and also in social and sporting activities, especially students. The results also indicate that farmers had a high incidence of hand infections. Factory workers are also prone to hand infections. In comparison, the Eseldeen et al, 1992, study also found hand infections to be common in young male manual and factory workers.

In my study the sex ratio was 1.8 males to 1 female. The sex ratio specifically to Katete was nearly 1:1, showing adult women were as much involved in manual labour as men. The sex ratio in the Eseldeen et al, 1992, study was 2 males to 1 female, which is close to the ratio in my study.

In my study 61% of the patients could not remember the source of the injury, suggesting that these injuries were often minute breaks in skin which allowed entry of organisms. Other factors were human and snake bites. In the Martin and Singer, 1976, study, 50% of the patients could remember the source of the injury. In the Brown et al, 1993, study, micro trauma was the cause in 60% of the cases and human bites were the cause in 25% to 30% of the cases. The latter also found drug abuse to be the cause in 10% to 15% of the cases. Drug abuse was not found as a cause in my study as drug abuse is rarer in Zambia.

The most common organism isolated in my study was staphylococcus aureus in 71% of the cases. This correlates well with the Martin and Singer, 1976, study, which found staphylococcus aureus in 80% of the cases. The Eseldeen et al, 1992, study isolated staphylococcus aureus in 51% of the cultures. The American study by Brown et al, 1993, found that about 65% of all hand infections are caused by aerobic organisms -60% pure gram - positive and 5% pure gram- negative. They also found staphylococcus aureus to be the most commonly isolated organism in hand infections,(35% of cases). The latter also found 35% of cultures from hand infections grew anaerobic organisms. It was difficult to culture for anaerobes in my study due to lack of culture media. Beta haemolytic streptococcus was the second commonest organism isolated in my study, (19%), which compares well with the Martin and Singer, 1976, study which found it in 5% to 10% of the cultures.

The sensitivity pattern of staphylococcus aureus was different in Katete and Lusaka. It was not possible in this study to determine the sub types of staphylococcus aureus. Staphylococcus aureus in Katete was sensitive to ampicillin, gentamicin and tetracycline, whereas in Lusaka it was resistant to these three, especially ampicillin and tetracycline, .. Over 90% of Lusaka species were sensitive to cloxacillin, chloramphenicol, erythromycin and cotrimoxazole. This difference could be due to different sub types of organisms in Lusaka and Katete; or might suggest that there is abuse of ampicillin and tetracycline in Lusaka. In Katete the resistance was mainly to chloramphenicol. This could be due to this antibiotic being commonly used in this hospital. Brown et al, 1993, found that oral combination of a broad spectrum penicillin and a beta - lactamase inhibitor, such as amoxicillin/ clavulanic acid, to be effective against most hand infections. Amoxicillin is effective against gram positive organisms, most gram negative organisms and most anaerobes. Erythromycin was used for patients with penicillin allergies. Hausman et al, 1992, found a first generation cephalosporin and penicillin combination to be effective against septic hand infections.

In my study nearly 62% of the spaces involved the fingers. This correlates well with the Martin and Singer, 1976, study,(60%), and the Eseldeen et al, 1992. study, (70%). It also compares well with the American series by Brown et al, 1993 (60%). This could be due to mobility, activity and the exposed position of digits during the act of gripping objects.

In my study the three complications, (frozen hands) were due to prolonged purulent infection because of late presentation that eventually extended deeper into tissues without any treatment and consequent necrosis of structures. Eseldeen et al, 1992., (Khartoum), had two serious complications resulting in above elbow amputations. Brown et al, 1993, (America), experienced no serious complications. The latter could be due to early presentation to hospitals in the American environment.

In my study the average time lost from work was 16 days from the time of the start of the symptoms to the start of treatment and return to work. Early incision and drainage and active physiotherapy were important in reducing morbidity. Eseldeen et al, 1992 found the average time lost to be 20 days. The average time lost among 151 patients studied by Wilkes, 1954, in Great Britain was 21 days.

13. CONCLUSION.

My study found staphylococcus aureus to be the most common aerobic organism in hand infections in both rural and urban Zambia. Most rural patients presented late to hospital compared to the urban population. All three cases of frozen hands were in Katete due to late presentation of more than three weeks after the beginning of the symptoms. Most of the infections involved were the fingers - nearly 60%, and this is understandable as the fingers are used in gripping various objects. Sensitivity of the organism depends on the environment and antibiotic usage in that environment. In Lusaka the antibiotic of choice should be cloxacillin, while in Katete a cheap antibiotic such as tetracycline would be helpful in controlling infection after incision and drainage.

Farmers were found to be the most susceptible profession to hand infections. The majority of patients were found to be between 20 and 40 years of age;

14. RECOMMENDATIONS.

- (a). Early appropriate treatment is recommended, including timely drainage.
- (b). Early post operative elevation of the hand with early flexion - extension of the fingers is advocated.
- (c). Immediate antibiotic cover with either cloxacillin (Lusaka) or tetracycline (Katete), should be started. The antibiotic may be changed depending on the culture sensitivity results.

15. REFERENCES.

- (1). Bailey H. – 1986 ,
Demonstration of Physical Signs in Clinical Surgery 17th edition,
Bristol,IOP Publishing Limited, pp 478 - 489.
- (2). Bell. M. S. - 1976.
The Changing Pattern of Pyogenic Infections of the Hand,
The Hand. 8:289,
- (3). Botte Michael. J. and Abrams. A. Reid. - 1996,
Hand Infections -Treatment Recommendations for Specific
Types,
Journal of American Academy of Orthopaedic Surgeons,
2 : 219 - 230.
- (4). Brown. M. David, MD, and Young. V. Leroy, MD. -1993,
Hand Infections,
Southern Medical Journal, Saint Louis,Missouri
1: 20-29
- (5). Clark A.,Wilgis C.,Aiello B.,Eckans D. and Eddington S. – 1993,
Hand Rehabilitation - A Practical Guide 2nd Edition
New York, London: Churchill and Livingstone, pp1- 17.
- (6). Cowen J. Norman, MD, -, 1990
Practical Hand Surgery, 4th Edition
Chicago, London: Year Book Medical Publishers; pp 493 - 510.
- (7). Curr. J. F. - 1945.
The Use of Penicillin in Acute Infections of the Hand,
Edinburgh Medical Journal. 52:469,
- (8). Eseldeen K.; Fahal A.A.and Ahmed. A.E. -1992,
Hand Infections in Khartoum Teaching Hospital,
East African Medical Journal November: 55 - 60.
- (9). Green S. - 1988,
Operative Hand Surgery, 2nd Edition
Chicago, London, New York: Churchill and Livingstone,
pp 1027 - 1049.
- (10). Hausaman L. and Lisser S. - January 1992.
Hand Infections,
Orthopaedic Clinics of North America ;1: 1-40,

- (11). Hooper G. - 1985,
A Colour Atlas of Minor Operations on The Hand, 4th Edition
London: Wolfe Medical Publications, pp 8 - 11.
- (12). Johnstone. K. Molton, MD. – 1973
The Hand Book 7th Edition
Illinois: Charles C. Thomas Publishers, pp 62 - 67.
- (13). Lister G. - 1978
The Hand - Diagnosis and Treatment, 6th Edition
London, New York: Churchill and Livingstone, pp 117 - 133.
- (14). Macfarlane P. and Thomas J – 1981,
Text Book of Surgery, 4th Edition,
New York London: Churchill and Livingstone, pp 601 - 604.
- (15). Martin P. and Singer S. - 1976,
Hand Infections - Approach and Management,
South African Medical Journal, 3: 35 - 40.
- (16). McConnell. C. M. and Neale H.W. - 1979.
Two - Year Review of Hand Infections at a Municipal Hospital,
Journal of American Surgery 45:643,
- (17). Napier. J. R. - 1956,
The Prehensile Movement of Hand,
Journal of Bone and Joint Surgery, 38b: 902 - 913.
- (18). Spiegel. J.D. and Szabo. R.M. - 1988.
A Protocol for the Treatment of Severe Infections of The Hand,
Journal of Hand Surgery. 13:254,
- (19). Tubiana T. - 1984.
Examination of The Hand and Upper Limb, 5th Edition
New York: W. B. Saunders Publishers, pp 1-30
- (20). Tubiana T. - 1985,
The Hand, 3rd Edition
New York: W.B. Saunders Publishers, pp 3 - 5.
- (21). Way L. - 1985,
Current Surgical Diagnosis and Treatment, 11th Edition
New York ,Chicago: Lange, pp 1076 - 1078.
- (22). Wood Jones. F. - 1942.
The Principles of Anatomy as seen in Hand, 1st Edition
Baltimore: W.B. Saunders Publishers, pp 1-4
- (23). Wynn Parry - 1981,
The Rehabilitation of The Hand, 4th Edition,
Chicago, London: Butterworths Publishers, pp 1 - 34.

ACKNOWLEDGEMENTS.

I would like to thank the following people for their assistance in the preparation of this project.

- (1). Professor K. Erzingatsian, for advising me on the thesis.
- (2). Mr. Cairns, the Superintendent of Saint Francis Hospital, Katete.
- (3). The laboratory staff at Saint Francis Hospital, Katete.
- (4). The Microbiology staff at the University Teaching Hospital.
- (5). Mr. Mohammed Koya, for assisting me with the final printout of the thesis.
- (6). To my dear wife, Shazia, for bearing with me for the extra time spent away from home, during this project.
- (7). All the patients who had the patience and who agreed to be involved in this project.
- (8). The Ethics committee of the University of Zambia for their approval of this project.