

PATTERN OF
PRESENTATION
AND SHORT TERM
MANAGEMENT
OUTCOME OF
HAND BURNS AS
SEEN AT
KENYATTA
NATIONAL
HOSPITAL

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outcomes of hand burns as seen at Kenyatta National
Hospital ^

By

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A dissertation submitted as part fulfillment of the
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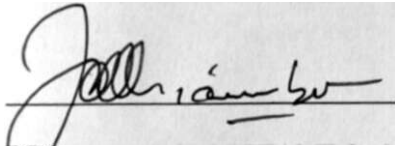
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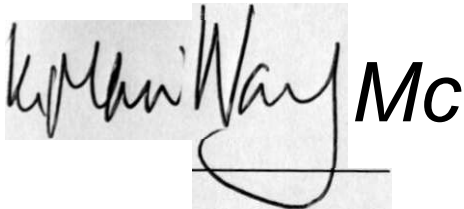


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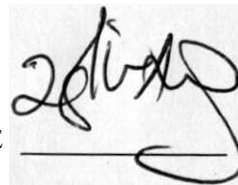
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DEDICATION

To my wife Roselyne and daughter Renee.

All children who have suffered hand burns.

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ABBREVIATIONS

SPSS	Statistical Program for Social Scienci
KNH	Kenyatta National Hospital
TBSA	Total Burns Surface Area
BSA	Burns Surface Area
K-Wire	Kirschner Wire
AC	Alternating Current
DC	Direct Current
MPJ	Metacarpophalangeal Joint
IPJ	Interphalangeal Joint
STSG	Split Thickness Skin Graft

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ABSTRACT

This study looked at the pattern of hand burn injuries as seen at KNH during the study period. It covered children in the 0 - 13 years age group category admitted at the hospital. It comprised both prospective and retrospective components with the aim of establishing the pattern of presentation of hand burns, current management modes and short term management outcomes as seen at the plastic surgical unit in KNH.

The study covered a period of three months prospectively from 1st June 2004 to 31st August 2004 during which 34 cases were seen having met the inclusion criteria. It also retrospectively looked at 531 cases from 1st September 1999 to 31st May 2004.

The main parameters documented were patients age, sex, residence, family size, place of burn, site of burn, degree of burn, management mode and outcome of burn. The data was collected using a questionnaire and SPSS computer package used for analysis.

In the study it was observed that there was an equal sex distribution of hand burns and that the age group of 1 - 5 years was the most affected amongst children of age thirteen years and below. Most hand burns occurred in the cooking areas and were mainly caused by hot fluids. The majority of patients (76.5%) were brought to hospital within the first 24 hours of injury. Burn injuries were mostly managed conservatively and for the few who required surgical care the commonest surgical procedure carried out was escharotomy, while early excision and grafting was carried out infrequently. Most patients (61.8%) recovered fully with no complications; however up to 20.6% developed debilitating complications like loss of digits and contractures.

From the findings in this study it is recommended that a more pro-active approach in the management of hand burns should be undertaken whenever these injuries are diagnosed; this should include early excision and grafting of burn wounds. In order to provide this kind of optimum care, specialized units well versed in set national hand burns management protocols should be established so as to minimize debilitating complications of these kind of injuries.

INTRODUCTION

DEFINITIONS

A burn is a coagulative damage in the cells of the body after insult by physical heat / thermal, chemical, electrical, frictional or radiation agents.

ETIOLOGY OF BURNS

Burn wounds can be classified into six (6) separate groups based on the aetiology; scalds, contact burns, fire, chemical, electrical and radiation.

Scald burn injuries can be caused by liquids, grease or steam. Hot scalds can further be subdivided into spill and/ or immersion burns'. Open fire burns injuries can be classified as flash or flame burns'.

In electrical burns, injury extent depends on; the amount of current (low voltage household 120-440v) current (alternating current (AC) or direct current (DC) path of current (hand to hand; hand to foot, foot to foot) length of contact and the events associated with the injury (fall, burns, water contact)².

Radiation burns can be caused by sunrays, heaters or welding rays; chemical burns are as a result of either alkaline or acidic media and occur when exposed to chemicals like cement, fertilizers, insecticides, cleaning agents, petrol or tar.

CLASSIFICATION OF BURNS AREA

The direct injury caused by a burn produces an initial volume of irreversibly damaged tissue, surrounding which is a region of tissue that has suffered reversible injury. The final depth and extent of the injury depends upon the extent to which these adjacent sub lethally injured tissues recover⁴: survival of these adjacent tissues is influenced by the hosts physiological response, which includes response, and by environmental factors, including infections and the efficacy of topical treatment. The evolution of the depth and extent of the wound requires daily and observation over the initial three to five days following injury so that the damage can be accurately assessed⁴: accurate estimation of depth is important in determining treatment and prognosis.

DEPTH OF A BURN AREA

The traditional classification of burns by depth as first, second and third degree is being replaced with designations of superficial, superficial partial thickness, deep partial thickness and full thickness. In superficial burns, minor epithelial damage of the epidermis occurs, redness, tenderness and pain are the hallmarks of this injury. Blistering doesn't occur and two-point discrimination remain intact. Superficial partial thickness burn involves the epidermis and superficial (papillary) dermis, often result in thin walled, fluid-filled blisters. Deep partial-thickness burns extend into the reticular dermis, skin colour is usually a mixture of red and blanched white and capillary refill is slow. The above two have traditionally been referred to as second degree burns. Full thickness burns involve both epidermis and dermis capillary network of the dermis is completely destroyed and the area has a white or leathery appearance with underlying clotted vessels and is anaesthetic^{2,5,6}.

Although accurate classification is not always possible initially, however the causes and physical characteristics of burns wound maybe helpful in categorizing their depth (table 1)^{5,6} Burn depth has an impact on healing time, the need for hospitalization, surgical intervention and the potential for scarring. Thin skin tend to sustain deeper burns injuries than may be suggested by the initial appearance of the wound⁷, thin skin is found on the medial surface of the arm, medial thigh, perineum and ears. All skin except the palmar surface of hand and sole of the foot can be presumed to be thin in children younger than five years and adults older than fifty five years^{7,8}.

TABLE 1**Classification of burns based on depth** ^{5,7}**Characteristics**

Classification	Cause	Appearance	Sensation	Healing Time	Scarring
Superficial burn	Ultraviolet light, very short flash (flame exposure)	Dry and red; blanches with pressure	Painful	3 to 6 days	none
Superficial partial - thickness burn	Scald (spill or splash), short flash	Blisters; moist, red and weeping; blanches with pressure	Painful to air and temperature	7 to 20 days	Unusual; potential pigmentary changes
Deep partial - thickness burn	Scald (spill), flame, oil, grease	Blisters (easily unroofed); wet or waxy dry; variable color (patchy to cheesy white to red); does not blanch with pressure	Perceptive of pressure only	More than 21 days	Severe (hypertrophic) risk of contracture
Full- thickness burn	Scald (immersion), flame, steam, oil, grease, chemical, high-voltage electricity	Waxy white to leathery gray to charred and black; dry and inelastic; does not blanch with pressure	Deep pressure only	Never (if the burn affects more than 2% of the total surface area of the body)	Very severe risk of contracture

EXTENT OF BURNS

The extent of a burn is expressed as a percentage of total body surface area (T.B.S.A.) affected by the injury. Accurate estimation of T.B.S.A. of a burn is an essential guide to management. T.B.S.A. can be estimated using any of the following evaluation methods^{9,10,11}.

- Rule of nines; divides the body into eleven (11) areas of nine (9%) percent each, namely each upper extremity (9%), anterior (9%) and posterior (9%) portions of each, lower extremity, upper extremity (9%), anterior upper (9%) and lower (9%) portions of the trunk, posterior upper (9%) and lower (9%) portion of the trunk and the head and neck (9%). The prenum comprises the remaining one per cent (1%) to make a total of hundred percent (100%)^{9,10}.
- A quicker but less accurate method for determining burn size is to use the palm of the patient's hand^{10,11,12}, which is roughly equivalent to 1% of the patient's. Burn surface

Area (B.S.A.). The palm of the hand approach is most convenient for splash-type, non confluent burns and should never be used for extensive burns (>10% B.S.A.)¹².

- The most accurate method is with the Lundh and Browder chart⁹. These charts are available for different age groups, and it is the method of choice used in Kenya and at Kenyatta National Hospital.

LOCATION OF BURN INJURIES

The anatomical site of burns has a important bearing on outcome, morbidity and mortality to the patient. It is also a guide to specific treatment modalities, reconstruction and rehabilitation. The face, neck, hands, feet and perineum are considered as special areas and significant burns of these areas bear severe morbidity regardless of the extent and depth of the burn injury.

INHALATION INJURY

Inhalation injury has a significant impact on the survival of burns patients. It has three components namely: carbon monoxide inhalation, direct thermal injury to the upper aerodigestive tract and inhalation of products of combustion^{1,13,14}. Any one may be present or absent in a given victim of inhalation injury. All should be searched for, diagnosed and treated independently and appropriately.

Diagnosis may be difficult, but a high index of suspicion in certain fire situations e.g. closed spaces maybe relevant. Singed nasal hairs, facial or oropharyngeal burns and expectoration of carbonaceous sputum are occasionally seen^{1-14, 15}. Signs of upper respiratory obstruction such as crowing, stridor or air hunger usually signify a significant injury to the hypopharynx/larynx.

All patients suspected of having inhalation injury should have arterial blood gases drawn, including determination of CHgb level. CHgb levels > 10% are probably significant; levels >50% are associated with death. If the carboxyhemoglobin level is elevated the patient should immediately be administered 100% oxygen^{16,17}.

The treatment of inhalation injury is mainly supportive. The primary goal in the initial treatment is airway maintenance. Endotracheal intubation is recommended in the setting of

inhalation injury or its suspicion. If carbon monoxide poisoning is present 100% oxygen is given. For the other components of inhalation injury, treatment is ventilatory support until the mucosal barrier reforms. Adequate ventilatory support, with the use of positive end respiratory pressure (PEEP), if necessary, is mandatory to keep systemic oxygenation in the normal range^{14,16,17}.

While 75% of fire related paediatric deaths occur as a result of house fires, most of these deaths are caused by anoxia or exposure to toxic gases rather than burns injuries^{13,15}.

LITERATURE REVIEW

The hand forms the distal extremity of the upper limb extending from the wrist to the fingers. The hand serves three basic functions; sensory perception, precise manipulation and power grip. The first two functions involve the thumb, index and middle fingers; without normal sensation and the ability to oppose these three digits, manipulative precision will be lost. The ring and little fingers provide power grip, for which they need full flexion; sensation is less important for these¹⁸.

With the wrist flexed the fingers and thumb fall naturally into extension. With the wrist extended the fingers curl into flexion the tips of the thumb, index and middle fingers form a functional tripod: this is the "position of function", because it is best suited to the actions of prehension. Finger flexion is strongest when the wrist is powerfully extended; normal grasp is possible only with a painless, stable wrist. Spreading the fingers produces abduction to either side of the middle finger; bringing them together, adduction. Abduction and adduction of the thumb occur in a plane at right angles to the palm (i.e. with the hand lying palm upwards, abduction points the thumb to the ceiling). By a combination of movements the thumb can also be opposed to each of the other fingers. Functionally, the thumb is 40% of the hand^{18,19}.

ANATOMY OF THE HAND

The palmar skin is relatively tight and inelastic; skin loss can be ill afforded and wound sutured under tension are liable to breakdown. The acute sensibility of the digital palmar skin cannot be achieved by any skin graft. Although the dorsal skin seems lax and mobile with the fingers extended, flexion will show that there is very little spare skin, loss of skin therefore often requires a graft or flap¹⁷.

Deep to the palmar skin is the palmar aponeurosis, the embryological remnant of a superficial layer of finger flexors; attachment to the bases of the proximal phalanges explains part of the deformity of Dupuytren's Contracture. Incisions on the palmar surface are also liable to contracture unless they are placed in the line of the skin creases, along the mid-lateral borders of the fingers or obliquely across the creases.

MOVEMENTS OF THE HAND

The second and third metacarpals have very little independent movement; the fourth and fifth have more, allowing greater closure of the ulnar part of the hand during power grip. The metacarpal of the thumb is the most mobile and the first carpometacarpal joint is a frequent target for degenerative arthritis. The metacarpophalangeal joints flex to about 90°, the range of extension increases progressively from the index to the little finger. The interphalangeal joints are simple hinges, each flexing to about 90°. The movements of the thumb take place in planes at right angles to those of the other digits because the thumb is rotated medially through 90 degrees. Flexion and extension of the thumb take place in the plane of the palm; and abduction and adduction at right angles to the plane of the palm. Movement of the thumb across the palm to touch the other digits is known as opposition. This movement is a combination of flexion and medial rotation^{18,19}.

EPIDEMIOLOGY

More than 1,000 children in North America under the age of 15 years die in house fires each year and about two-thirds of them are under the age of 4 years²⁰. Additionally 20,000 children require hospitalization out of the approximately 440,000 children who receive medical attention each year²¹. In a study done in Libya, 48% of all burns admissions were children they comprised 59.24% of all patients seen at the emergency department²². Recent analytical studies concerning injuries have established that the hand and wrist are affected in 35.8% of cases²⁴. Hand burns can either be located only on the hand or be part of a larger burned body surface. Each clinical type requires a specific therapy until full recovery. The male sex is more affected with a rate of approximately 60.48% against 39.52% in females²⁵. This can be explained by the nature of work done by adult males and which renders them more susceptible to sustaining hand burns and the fact that male children tend to be more active and inquisitive thus likely to touch hot substances. Upto 32.1% of total hand burns are found to affect the 1 - 12 years age group²⁶.

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There are two main clinical types of hand burns :-

- a) Exposed - burns mainly on the dorsal side
- b) Contact - burns mainly on the volar side.

Dorsal hand burns are usually in both hands. The hand by reflex action clenches and covers the face^{2**29}. The back of the hand cannot however be protected by the mechanism of clenching. Dorsum skin is thin, has less subcutaneous tissue, and is therefore liable to deeper burns^{7,8}. The burn usually affects tendons, muscles, bones and joints^{1*2V}. Palmar burns are usually isolated injuries in one hand only, and are rarely part of a larger burned surface. In most cases these are deep burns affecting deep functional structures.

They are generally not life threatening, but their treatment is complicated and complex^{26 28,29}. In everyday life we encounter various causes of hand burns. These include; flames, hot liquids, chemicals, electricity, radiation etc. Previously flames were the commonest cause of hand burns but more recent studies have shown that scald burns are becoming the commonest cause of hand injuries^{23,24}; albeit other recent studies still show that flame burns are still the main cause^{25,30}. However it appears that the main cause of these injuries depend on the socio-economic factors which determine the kind of fuel sources, family size and parental care of the children^{23 25,30}. The other presentation of hand burns in children occurs in cases of child abuse; children are the most likely victims of intentional burns as they are the most defenseless human beings. Child abuse burn victims are almost always under the age of 10 years with a majority under the age of 2 years and most present with scalds or contact burns. Gary et al found out that upto 20% of burn unit paediatric admissions in their centres were related to child abuse³¹. Immediate identification of intentional burn victims by those individuals first responding to the call for assistance is crucial because most of the victims are unable to speak for themselves. It is also important that responsible caretakers not be unjustly accused^{20,2131}.

DYNAMICS OF BURNS OF THE HAND

Children tend to get exposed to circumstances, which can lead to them sustaining burns if they are not monitored closely. Hand burns occur in children by various mechanisms as a result of exposure to different aetiological factors.

Children sustain hand burns from hot fluids when they open hot water taps as they try to wash their hands, they can also scald their hands when dipping them in containers with hot

fluids or bathtubs with hot bathing water. Children can also sustain hand burns when they come in contact with hot objects e.g. hot irons, barbecue grills, oven doors, pan handles, or hot spoons in cooking pots. These burns mainly affect the palmar aspect of the hand^{26,28}. Flame burns cause injury to the hand when children come to contact with open flames at fire places, open jikos, cigarette lighters, fire works or when loose cloth sleeves catch fire. When children are left to play with matchboxes they can also suffer open flame burns.

Electrical hand burns may occur when children insert wires into open electrical wall outlets or when they come into contact with open live electrical wires². It is thus important to closely monitor young children and keep them away from cooking areas and also not to leave cooking places unattended. It is also important to cover all electrical outlets so as to make the home safe.

MANAGEMENT OF BURNS OF THE HAND

The multi disciplinary treatment of burns of the hand begins on the day of injury and may be carried out simultaneously with resuscitation and other treatment if the burn involves a large body-surface area^{1,4,5}. Burns management should usually start at the site where the burn is sustained continued while patient is admitted in a hospital set-up and finally followed up by rehabilitation.

MANAGEMENT AT SITE OF BURNS INJURY (PRE-HOSPITAL CARE)

The immediate thing to be done by the person near a child who has been exposed to a burn is to immediately stop the burning by either removing the victim from the source or by extinguishing the fire if it is an open flame. Secondly we need to cool the burnt or scalded area for at least 10 minutes under copious and gently flowing water irrespective of cause^{5,17}.

Remove any clothing that has been burnt or soaked with hot liquid by carefully cutting it away. Do not pull the clothes over the child's head, if any material sticks to the injury do not attempt to pull it free, cool the material as well as the burn. Gently cover the injury with a clean, non fluffy cloth or dressing. Do not cover the burn tightly as it may swell. While at the pre-hospital setting anxiety and panic should be allayed and immediate transport to hospital arranged⁶.

HOSPITAL CARE OF BURNS PATIENTS

Once patient arrives in a hospital setup at the emergency department the initial approach is similar to that of any other major trauma patient, as suggested by the American College of surgeons in the Advanced Trauma Life -Support (A.T.L.S) course. Assessment begins with a primary survey, which is immediately followed by a secondary survey. After this has been undertaken decisions are made on the need for admission into a specialized unit so that definitive resuscitative therapy can be instituted.

PRIMARY SURVEY

During this initial assessment the clinician must see to it that the patient has an adequate airway free of any obstruction and is able to breathe adequately. However, if the patient is not breathing well because of either an obstructed upper airway or a depressed depth or frequency of breathing, endotracheal intubation is necessary. For patients with associated cervical spine injuries, stability should be evaluated with at least a cross table lateral cervical spine radiograph prior to intubation^{14,17}.

As part of the primary survey, adequacy of the peripheral circulation should be determined early after the burn injury by palpation of peripheral pulses. Rapid determination of extent of burns injury is important as fluid is transferred to the area of injury from the vascular space within minutes and this fluid loss may result in hypovolemic shock; the greater the surface area involved, the more extensive the hypovolaemia. Initial volume resuscitation should begin immediately; following the introduction of at least two large bore intravenous catheters. Since patients with moderate burns often have an ileus that persists beyond the early days of treatment, a nasogastric tube should be used to decompress the bowel. A Foley catheter is also necessary to allow measurement of urine output accurately. During fluid resuscitation monitoring of vital signs is required to maintain an adequate urine output of at least 0.5ml/kg/h^{2,5,17}.

SECONDARY SURVEY

Secondary survey begins with a detailed history and physical examination from head to toes with the aim of detecting any associate injuries. It is important to record a detailed burn diagram and immediately administer tetanus prophylaxis and analgesics preferably intravenously. During this time it is also important to cover the wounds with clean towels.

In case of chemical burns irrigation with copious amounts of saline is done before the injuries are covered with clean towels⁵⁶.

- **INITIAL CARE**

Following both the primary and secondary surveys, a multidisciplinary treatment of burns of the hand begins immediately and may be carried out simultaneously with resuscitation and other treatment if the burn involves a large body surface area. Oedema formation in burned hands hinders motion and may be a factor in later contracture formation. The hands must be elevated above the level of the heart at about 45° to prevent oedema formation, however close monitoring is required in children as this may lead to congestive cardiac failure^{17,32}. Evaluation of radial, ulnar and palmar arch pulses should be undertaken by palpation or Doppler ultrasound at the time of initial evaluation and hourly thereafter¹³². Pain management is also instituted during this period. Aspirin and morphine may be used. Narcotics and other parental medications that are administered should be given intravenously, not intramuscularly, since drugs are poorly absorbed from muscular tissues during hypovolemic shock.

Ideally all hand burn patients are admitted for further management, however electrical burns, chemical burns and in cases of abuse a must admission strategy should be followed. Once in hospital management is either by conservative measures, surgical measures or both.

CONSERVATIVE MANAGEMENT

- **Cleansing**

Burned hands should be cleansed twice daily with a mixture of water and chlorhexidine gluconate or soapy solution such as savlon, and then washed off with saline^{1,8}. Burns that are clearly partial thickness may be managed with one-percent (1%) silver sulphadiazine cream. Indeterminable burns are placed in alternating agents, which include mafenide acetate during the day and silver sulphadiazine at night. Burns that are obviously full thickness or potentially infected are treated with twice-daily mafenide acetate^{17,32-33}. Regular wound swabs should be taken during treatment. There is however no place for the prophylactic administration of antibiotics or treating swab results. Their use should be reserved for clinical infection as indicated by cellulitis and pyrexia, and must always be given parenterally.

- **Dressings**

If it is judged that a burn is superficial and that it will heal within one week, suitable non-adherent dressings are undertaken. These include Tulle-Gras, Silicone NA or Xeroform gauze. These semi-occlusive dressings provide coverage to the wound and also reduce pain considerably. Fingers are best dressed individually using tubigauze or with composite dressings^{6 7 34 35}. There are an endless list of synthetic and biosynthetic dressings which are continuously recommended for use in topical treatment of burn wounds. A semipermeable hydrocolloid dressing with properties based on carboxymethylcellulose was studied at La Paz Hospital and it was found that with its use post-application pain, discomfort and bad odours were infrequent which made it a better therapy than other topical applications³⁴. Epithelialization time is also shorter than that necessary with classical techniques^{34,35}.

- **Topical antimicrobials**

Most partial thickness burns of less than 10% TBSA respond satisfactorily to daily antibiotic dressings. Silver sulphadiazine remains the most popular antimicrobial cream⁶⁻⁷. If the patient is allergic to sulphur alternative agents include polysporin, bacitracin³³ and bactroban. Mafenide is an alternative agent that penetrates burn eschar more effectively than silver sulphadiazine hence it is frequently used on infected wounds that do not respond to silver sulphadiazine; however mafenide should be used with caution because it can induce metabolic acidosis¹⁷. In cases of burn wound colonization with fungi topical nystatin can be added to above gels to cover these.

- **Positioning and splinting**

Positioning and splinting of burned hands is paramount. When a burned hand is not properly splinted or positioned it can lead to various deformities as a result of development of contractures. These result in major deformities especially in children leading to long term disabilities. The collateral ligaments of the metacarpophalangeal (MP) and interphalangeal joints (IP) are the most important structures of the burned hand and for this reason positioning of the burned hand should place the MP joints at maximum flexion (i.e. 90°) to maximally stretch the collateral ligaments^{29,36}. The anatomic position for splinting involves 40° of wrist extension, MP joints at 90° of flexion and IP joints fully extended. The thumb

should be fully abducted^{17,29,36}. Use of a volar cock-up splint extending from forearm to palm is recommended in the first 24 to 48 hours^{17,29,36}.

Currently hand therapists are moving away from active ranging as opposed to static splinting. Static splints are more often now used only in unco-operative patients or at night when patient is sleeping. Continuous passive motion machines where resources are available are becoming a useful adjunct to hand therapy, although when the burn involves the finger there is limitation on the point to attach the machine^{34,37,38}.

Open metacarpophalangeal or interphalangeal joints involvement and fingertip burns can also be splinted by maintaining the hand in a functional position by temporary Kirschner wire arthrodesis of the joints^{36,39}.

- **Occupational therapy and Rehabilitation**

Occupational therapy has a major impact on hand function following thermal injury thus an occupational therapist must evaluate the patient within the first 24 hours of admission^{28,36}. In the management protocol the need for anaesthesia is assessed before exercises are begun. Dressing should not restrict movement and the exercises should always be active unless patient is unable to comply. Normal daily activities should be encouraged^{28,29,36,38}.

SURGICAL MANAGEMENT

- **Blister management**

Whether or not to break blisters remains controversial. Some burn surgeons routinely debride all blisters, while others never break intact blisters. Some debride blisters only when on the hand, while others leave palmar blisters alone and debride dorsal hand blisters. The claimed advantage of leaving blisters alone is that the intact blister provides an autogenous burn dressing. The rationale for not debriding palmar blisters is that palmar skin is specialized and difficult to replace with graft³². However, it is advisable to debride all hand blisters assuming that hand motions would likely rupture the blisters and provide a possible portal of infection.

- **Escharotomy and fasciotomy in hand burns**

Escharotomies are often performed incorrectly, there being either a failure to release the full length of the burn or poor placing of incisions with damage to nerves or exposure of deeper structures. If the fingers are severely burned, digital escharotomies should be performed along their mid-lateral sides, preferably on the ulnar aspects of the second, third and fourth digits and the radial aspects of the fifth. This procedure minimizes scars on the primary working surfaces of the fingers^{17,32}.

Escharotomy of the thumb is best performed along the mid lateral radial aspect. The thenar and hypothcnar muscle compartments are often involved in severe hand burn injuries; eschar, and if necessary, fascia over these compartments should be incised. In deep hand burns, dorsal escharotomies with interosseous compartment fasciotomies should also be performed. The fasciotomies are performed through the dorsal escharotomies using a clamp spread longitudinally between the metacarpals^{17,32,36}.

In the extremities, eschar should be released until perfusion is restored to the distal parts. With deep thermal injury to the muscles of the hand or electrical injury, escharotomies should be combined with formal fasciotomies in affected muscle compartments³⁴.

- **Excision of Burns and grafting**

Excision of a burn is indicated when a burn is deep or if a burn has failed to heal after 14-21 days of conservative management^{36,39}. By early excision and grafting, full functional recovery may be achieved within 2 weeks and it also virtually abolishes pain and morbidity²⁹. Tangential excision and grafting within seven days is thus recommended for deep partial to full thickness skin loss^{17,29,36,40,41}. However several prospective studies have shown that final functional outcome of burned hands is not impacted by surgical management vis-a-vis non-

• **17 36**

operative care¹. This is subject to further studies and may depend on the specific management protocols of individual burn centres.

Early excision and grafting is however not justifiable in the following conditions^{42,43};

1. Charred hand; once the paratenon is affected this is an indication for a flap cover.
2. Children; since vascular risks are very important consideration.
3. Old patients.

The optimum time for early excision should be before the fourth (4th) day once

edema has receded but infection has not set in^{42,43}. The choice of graft type i.e. sheet graft over meshed graft depends on the plastic surgeon, though some studies show that the mesh graft gives better outcomes⁴² due to;

- a) Larger total surface area achieved,
- b) Good drainage through the holes,
- c) Significantly lower formation of haematoma and seroma,
- d) Rarity of infection

The graft is secured with sutures or staples, although fibrin glue has been found to be an acceptable alternative⁴⁴.

However mesh grafts give a cobblestone (leopardskin) appearance, which may not be acceptable to some patients cosmetically.

Although split thickness skin graft (STSG) is suitable for use on the dorsum of the hand, it is not acceptable in the palm or web spaces where contracture may lead to long-term functional problems.

Full thickness grafts are preferred in these sites, being associated with less contracture formation and providing more robust skin, more suited to the hand^{17 26 39}.

SPECIAL BURNS

- **Electrical burns**

These are notoriously difficult to assess, as there is usually considerably deeper damage than is evident on initial external inspection. High voltage injuries cause direct damage to blood vessels and muscle necrosis with the rapid onset of compartment syndromes^{17 32}. Involvement in the hand may result in swelling in multiple compartments. Serial fasciotomy needs to include decompression of the median and ulnar nerves, release of palmar spaces including the intrinsic muscles^{17,32}. The mainstay of management of high voltage injuries is aggressive debridement of all necrotic tissues. It is often difficult to judge the extent of skin and muscle necrosis at the first operation and it is better to delay skin cover until after a second procedure^{17 32}.

- **Chemical burns**

Exposure to chemical agents can occur at home, school or at play. Chemical agents can simply be classified as alkalis, acids or organic compounds. Alkalis appear as hydroxides

carbonates or caustic sodas, and are commonly found in oven and drain cleaners, fertilizers, industrial cleansers and rust removers⁴. The severity of a chemical injury is related to the specific agent involved, its concentration and duration of contact. Thus it is important that burns of the hands are continuously flushed with water until the pain significantly decreases or stops. Burns caused by acids may require 20 minutes or less to achieve this goal, while burns caused by strong alkalis may require several hours to several days of irrigation^{4,17,34}. Efforts to neutralize acids or alkalis should not be undertaken, as the generation of heat from this process may contribute to further tissue destruction³².

Chemical burns caused by hydrofluoric acid are a special consideration. Hydrofluoric acid is widely used as a metal or glass cleaning agent. It readily penetrates skin and causes burns that are painful and which have predilection for the nail-bed which lacks a stratum corneum. Hydrogen ions cause a characteristic coagulated acid burn. Fluoride ions cause progressive deep tissue necrosis and decalcification of bone which can continue for many hours. Following lavage with water, finger-nail should be trimmed and blisters de-roofed to ensure no acid is retained at the site of injury⁴⁵.

Calcium gluconate or carbonate gel should be applied topically to neutralize the fluoride ions. This can be supplemented by subcutaneous injections of calcium gluconate. Failure to relieve pain by these measures indicated continuing damage and a need for surgical excision^{17 32}.

COMPLICATION OF HAND BURNS

Complications commonly occur in hand burns if they are not managed well. These range from amputations of the digits if the burns are very deep or if escharotomy is not performed promptly once vascular compromise has been noted to contractures if spontaneous secondary healing of deep hand burns is allowed to take place as this type of healing has disastrous effects on the hand^{16,17,34}. Other complications include infections, which can either be soft tissue infections or can be deep enough to involve the bones causing osteomyelitis, which becomes very difficult to manage in the setting of a burned hand^{17,36}. Proper management of hand burns is geared towards reducing the possibility of developing such complications which may compromise hand functions. Burn wounds are also prone to

hypertrophy and this should be controlled by the application of customised pressure garments which need to be worn for much of the day^{36,51,52}.

There has been an increase in the number of burns cases amongst children being admitted at Kenyatta National Hospital. There has also been a number of child abuse by burning cases reported in the local newspapers. In the plastic surgical outpatient clinics a number of children are followed up with sequelae of hand burns like hypertrophic scars, contractures, 4 digit finger deformities, lock skin and finger amputations, which are preventable if proper emergency measures were put in place immediately they are brought to hospital. Yet no study to look at the pattern, management modes and complications has been undertaken locally in the recent past.

It is estimated that there should be more precise information regarding the concept of the severity of acute burn based on children. General practitioners and sometimes physicians in peripheral hospitals tend to evaluate the gravity of a burn more on the basis of its extent than on its localization in particular sites such as the hands, face, genitalia. In the case of children, although risk to life is limited, there is a high risk of morbidity leading to severe disfigurement.^{38,32,39,45}

During hand burn treatment, if attention is paid to basic principles; i.e. elimination of need for elevation and immobilization, infection prevention and early burn wound cover undertaken, the hand will most likely regain good functionality^{43,47}. A clear understanding of wound healing and scar contracture and good knowledge of the management of hand burns are essential if any sense is to be made of the myriad of deformities that may occur after hand burns. It is also important that apart from a plastic surgeon, the inclusion of a nurse fully conversant with management of burns, an orthopaedic surgeon specialized in management of hand injuries and physiotherapist/occupational therapist from the beginning in the management of hand burns should be considered seriously^{17,18,19,30}.

Thus in a nutshell we intend in this study to answer the following questions;
What is the pattern of hand burns in children as seen at Kenyatta National Hospital?
What are the management modes being undertaken currently and complications that follow?

RATIONALE OF STUDY

There has been an increase in the number of burns cases amongst children being admitted at Kenyatta National Hospital. There has also been a number of child abuse by burning cases reported in the local newspapers. In the plastic surgical outpatient clinics a number of children are followed up with sequelae of hand burns like hypertrophic scars, contractures and fixed finger deformities, keloids and finger amputations, which are preventable if proper management measures were put in place immediately they are brought to hospital. Yet no study to look at the pattern, management modes and complications has been undertaken locally in the recent past.

It is essential that there should be more precise information regarding the concept of the gravity of acute hand burns in children. General practitioners and sometimes physicians in peripheral hospitals tend to evaluate the gravity of a burn more on the basis of its extents than on its localization in particular sites such as the hands, face, genitals. In the case of handburns, although risk to life is limited, there is a high risk of morbidity leading to severe incapacitation^{28-32,36,46}.

During hand burn treatment, if attention is paid to basic principles; i.e. elimination of oedema by elevation and mobilization, infection prevention and early burn wound cover undertaken; the hand will most likely regain good functionality^{45,47}. A clear understanding of wound healing and scar contracture and good knowledge of the management of hand burns are essential if any sense is to be made of the myriad of deformities that may occur after hand burns. It is also important that apart from a plastic surgeon, the inclusion of a nurse fully conversant with management of burns, an orthopaedic surgeon specialized in management of hand injuries and physiotherapist/occupational therapist from the beginning in the management of hand burns should be considered seriously^{17,18,19,50}.

Thus in a nutshell we intend in this study to answer the following questions;

What is the pattern of hand burns in children as seen at Kenyatta National Hospital?

What are the management modes being undertaken currently and complications on follow up?

This study also aims at creating awareness to the general public and parents to enable them take preventive measures to help reduce the frequency of burns amongst children. It is also hoped that the study will give us a clue to the extent of child abuse related hand burns in our region.

STUDY OBJECTIVES

BROAD OBJECTIVE

To determine the pattern of hand burns injuries in Kenyatta National Hospital and their management outcome over a five (5) year period with a possible overview on the long term impact on the children with these type of injuries.

SPECIFIC OBJECTIVES

- (a) To determine the pattern of presentation of such injuries.
- (b) To determine the common causes and circumstances under which such injuries occur.
- (c) To review the current management modes and outcomes after management within Kenyatta National Hospital.

MATERIALS AND METHODS

• Study Design And Period

The study design was descriptive in nature and had two (2) components

- i. Prospective component from 1st June, 2004, to 31st August, 2004.
- ii. Retrospective component from 1st September, 1999, to 31st May, 2004.

The study was carried out at Kenyatta National Hospital and included all children under thirteen (13) years of age who had sustained burns injuries to the hands and attended to as in-patients over the study period. The data was analysed using the SPSS computer program and results summarized in form of tables, bar charts and graphs. Subsequently conclusions have been made and discussions on the same conclusions brought up.

• Study Materials

The study design was both retrospective and prospective descriptive.

The study materials included:-

- a) Index cards in the records department.
- b) Patient files in the records department.
- c) Records in the occupational /physiotherapy therapy centres.

All children that were admitted into Kenyatta National Hospital with hand burns within the study period were included in the study.

• Inclusion criteria

- All the patients aged between 0 - 13 years age admitted at the Kenyatta National Hospital with hand burns as the sole injury or as part of burns to other parts of the body.
- All types of burns thermal, chemical, electrical and radiation.

• Exclusion criteria

- Patients who presented with burn injuries but were treated as outpatients.
- Patients outside the 0 - 13 years age group

- **Sample size**

Over the three months that I rotated in the plastic Surgical unit, I noted that we were admitting an average of three children with hand burns per week translating to about 12 per month and 144 per year. I therefore estimate my sample size to be about 684 cases for the retrospective study and 36 cases for the prospective study.

Using a formula as recommended by Fisher et al in 1998 to determine sample size the following equation will be used namely;

$$N = \frac{Z^2 pq}{d^2}$$

where,

N = desired sample size (when population is greater than 10,000)

Z = standard normal deviate which is equal to 1.96 corresponding to the 95% confidence limit.

p = prevalence of the issue under study

q = 1.0 - p

d = the confidence limit of the prevalence (p) at 95% confidence interval

= 1 - Confidence interval

= 1 - 0.95

= 0.05

Degree of accuracy desired for the study hence set at ± 0.05

For the prevalence of the issue under study we will use figures from previous epidemiological studies which established the hand and wrist are affected in 35.8% of cases³⁷ and that up to 32.1% of total hand burns are found to affect the 1 - 13 year age group²⁵. This gives us a prevalence for hand burns in children in a population of burns patients of 11.4% per year.

Thus;

$$\text{Desired Sample Size} = \frac{(1.96)^2 \times 0.114 \times 0.886}{(0.05)^2}$$

$$\frac{0.388}{0.0025}$$

155

Sample size for this study is 155 over one year period using the Fisher et al formulae

- **Data Collection**

- The registration cards of all patients admitted into Kenyatta National Hospital with burns involving the hand were retrieved and patient numbers listed.
- Pre-testing was done to rationalize the questionnaire.
- The questionnaire was filled for all cases that satisfied the inclusion criteria.
- The prospective study cases were identified from the admissions into the plastic surgical unit. The clinicians attending the patients were consulted during the study periods; this involved also management of the patients while in the wards and follow-up in the plastic surgery out patient clinic.
- The investigator ensured that the patients and parents/guardian understood the purpose of the study and gave informed consent.

- **Data Analysis**

- After the data collection exercise, coding was done for all questionnaires and then entered into the statistical program for social sciences (SPSS) software.
- Analysis of data was done using the SPSS package.
- Retrospective and prospective data was analysed separately due to the fact that in the retrospective study the information in most cases was incomplete so that a comparison would not have been valid.
- The data was compiled using tally sheets and summarized in form of tables, bar charts and pie charts.
- Subsequently, a discussion of the results has been made followed by conclusions and recommendations.

ETHICAL CONSIDERATIONS

- A protocol of the research proposal was first submitted for approval to the ethical and research committee of Kenyatta National Hospital before study was undertaken.
- Study was commenced once the ethical and research committee approved the protocol.
- I carried out data collection and analysis, made conclusions and recommendations without personal bias or prejudice.
- Informed consent was taken from parent/guardian in the prospective study.
- * Clinical records and information was kept confidential and only used for the stated objectives of the study.

STUDY LIMITATIONS

The following limitations were experienced;

- Missing records, either files or history and physical signs as well as follow-up by clinicians.
- Patients who were lost to follow-up.
- * Time and financial constrains for researcher.
- Patients with hand burns who were wrongly discharged in casualty without being admitted to the ward for management.

ASSUMPTIONS

Cause of burns were accurately elicited/recorded.

Correct dressing techniques of the hand were followed and these were done regularly.

Physiotherapy and occupational therapy personnel regularly reviewed the patients and did the appropriate exercises.

Depth of burns was accurately diagnosed.

All surgical management were recorded e.g. blister rupture, escharotomy skin grafting.

RESULTS

A total of 34 children were studied prospectively over a (3)three month period. From our sample size calculation of 155 children per year, this gives us a sample size of approximately 39 children over (3) three months. Hence we were able to capture 87 percent prospectively. In the retrospective aspect a total of 531 children were captured.

Prospective data in black and retrospective in Red

TABLE I

A. DISTRIBUTION OF HAND BURNS BY AGE

	FREQUENCY	%	FREQUENCY	%
0 - 1 Years	9	26.5	100	18.8
> 1 - 5 Years	23	67.6	398	75.0
6- 12 Years	2	5.9	33	6.2
TOTAL	34		531	

Table shows that majority 23 (398) burns involving the hand occur in the 1 - 5yr age group 67.6% (75%)

B. DISTRIBUTION BY SEX

Of the 34 patients followed up prospectively 17 were found to be boys and 17 girls giving an equal distribution in terms of sex. This was also noted to be the same in the retrospectively reviewed data where out of 531 cases 270 (50.8) were boys and 261 (49.2) girls.

C. DISTRIBUTION BY RESIDENCE

Most cases of hand burns admission, at KNH were found to be from urban setups with 26 out of 34 in the prospective data and 481 out of 531 in the retrospective data.

TABLE 2

D. DISTRIBUTION OF HANDS BURNS BY FAMILY SIZE

	FREQUENCY	%	FREQUENCY	%
1 CHILD	8	23.5	25	4.7
2 CHILDREN	5	14.7	33	6.2
3 CHILDREN	11	32.4	184	34.6
4 CHILDREN	5	14.7	129	24.3
5 CHILDREN & OVER	5	14.7	160	30.1

Table shows that families with three children were the most likely to sustain hand burns 32.4% (34.6%)

TABLE 3**E. PERSON BRINGING CHILD TO HOSPITAL IN RELATION TO HAND BURNS**

	FREQUENCY	%	FREQUENCY	%
HOUSE HELP	0	-	2	0.4
FATHER	2	5.9	28	5.3
MOTHER	23	67.6	283	53.3
SIBLING	0	-	6	1.1
BOTH PARENTS	5	14.7	120	22.6
OTHERS	4	11.8	92	17.3

Table shows that the most likely person to bring child to hospital was the mother 67.6% (53.3%)

TABLE 4

F. DISTRIBUTION OF HAND BURNS BY PLACE OF BURN

	FREQUENCY	%	FREQUENCY	%
KITCHEN	25	73.5	336	63.3
BATHROOM	7	20.6	151	28.4
NEIGHBOURS HOUSE	1	2.9	6	1.1
OTHER	1	2.9	38	7.2

Table shows that most hand burns occurred in the kitchen environment 73.5% (63.3%)

G. CIRCUMSTANCES OF HAND BURN INJURIES

From the study most hand burns were found to be accidental with 33 out of 34 in prospective study and 497 out of 516 in the retrospective study. Of the prospective study 15 cases did not have proper records of the circumstances of the burns.

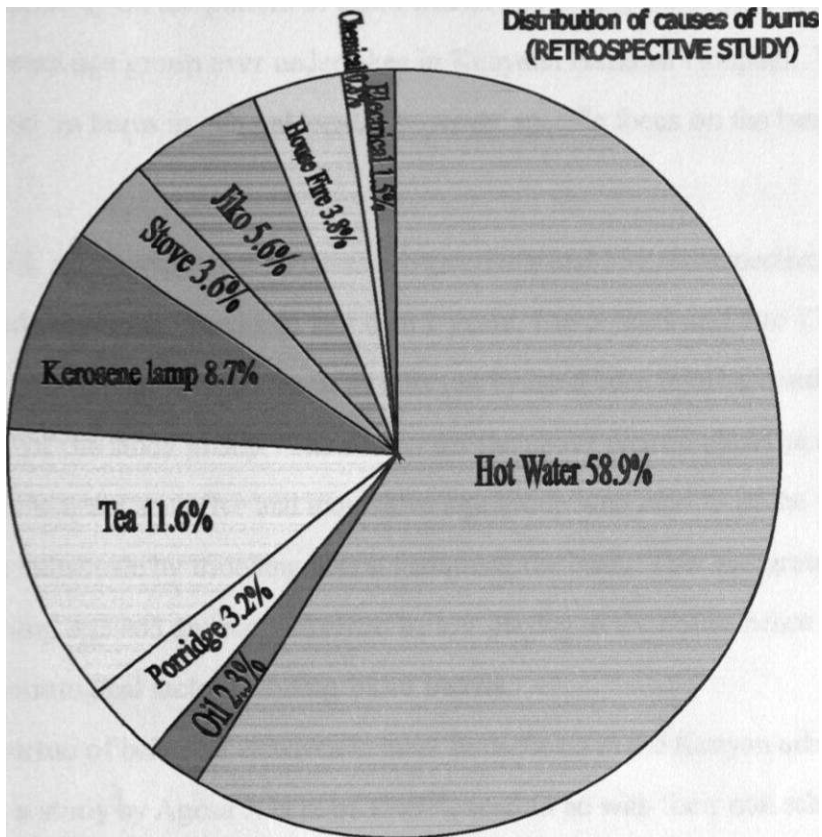


TABLE 3**H. DISTRIBUTION OF HAND BURNS IN RELATION TO CAUSES**

	FREQUENCY	%	FREQUENCY	%
HOT LIQUIDS	24	70.6	404	76.0
Water	20	58.8	313	58.9
Oil	0	-	12	2.3
Porridge	1	2.9	17	3.2
Tea	3	8.8	62	11.7
FLAME BURNS	9	26.5	115	21.7
Kerosene Lamp	4	11.5	46	8.7
Store	1	2.9	19	3.6
Jiko	3	8.8	30	5.6
House fire	1	2.9	20	3.8
CHEMICAL INJURY	0	-	4	0.8
ELECTRICAL	1	2.9	8	1.5

Table shows that the most common cause of hand burns were hot liquids 70.6% (76%) with hot water being the commonest at 58.8% (58.9%)

TABLE 6**I. DISTRIBUTION OF HAND BURNS BY DEPTH OF BURN INJURY**

	FREQUENCY	%	FREQUENCY	%
SUPERFICIAL	17	50	434	81.7
PARTIAL THICKNESS	15	44.1	64	12.1
FULL THICKNESS	2	5.9	17	3.2
UNSPECIFIED	0	-	16	3.0

Most hand burns were found to be superficial 50% (81.7%)

TABLE 7**J. DISTRIBUTION OF HAND BURNS BY HANDEDNESS**

	FREQUENCY	%	FREQUENCY	%
RIGHT HAND	14	41.2	244	46
LEFT HAND	12	35.3	219	41.2
BOTH HANDS	8	23.5	68	12.8

The right hand was found to be the most likely to be involved in burns 41.2% (46%)

TABLE 3**K. DISTRIBUTION OF HAND BURNS BY ANATOMICAL SITE**

	FREQUENCY	%	FREQUENCY	%
DORSAL ASPECT OF HAND	12	35.3	87	17.6
VOLAR ASPECT OF HAND	2	5.9	29	5.9
BOTH DORSAL & VOLAR ASPECT	20	58.8	379	76.6

Table shows that most hand burns involve both aspects of the hand

TABLE 9**L. DISTRIBUTION OF HAND BURNS BY NUMBER OF DAYS BEFORE PRESENTATION**

	FREQUENCY	%	FREQUENCY	%
1 DAY	26	76.5	466	89.1
2 DAYS	3	8.8	9	1.7
OVER 2 DAYS	5	14.7	48	9.2

After sustaining the burns most patients reported for treatment on day 1 76.5% (**89%**)

TABLE 10**M. MODES OF MANAGEMENT**

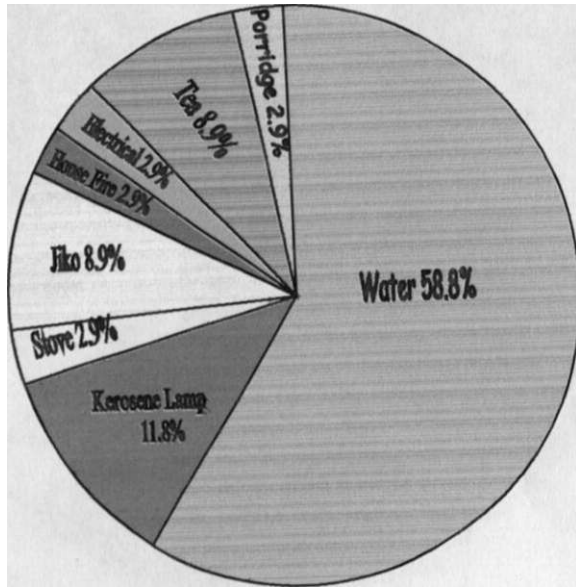
	FREQUENCY	%	FREQUENCY	%
CONSERVATIVE	21	61.8	372	70.1
ESCHAROTOMY	6	17.6	65	12.2
SURGICAL DEBRIDEMENT	4	11.8	15	2.8
EXCISION & GRAFTING BEFORE 14 DAYS	0	.	23	4.3
EXCISION & GRAFTING AFTER 14 DAYS	3	8.8	56	10.5

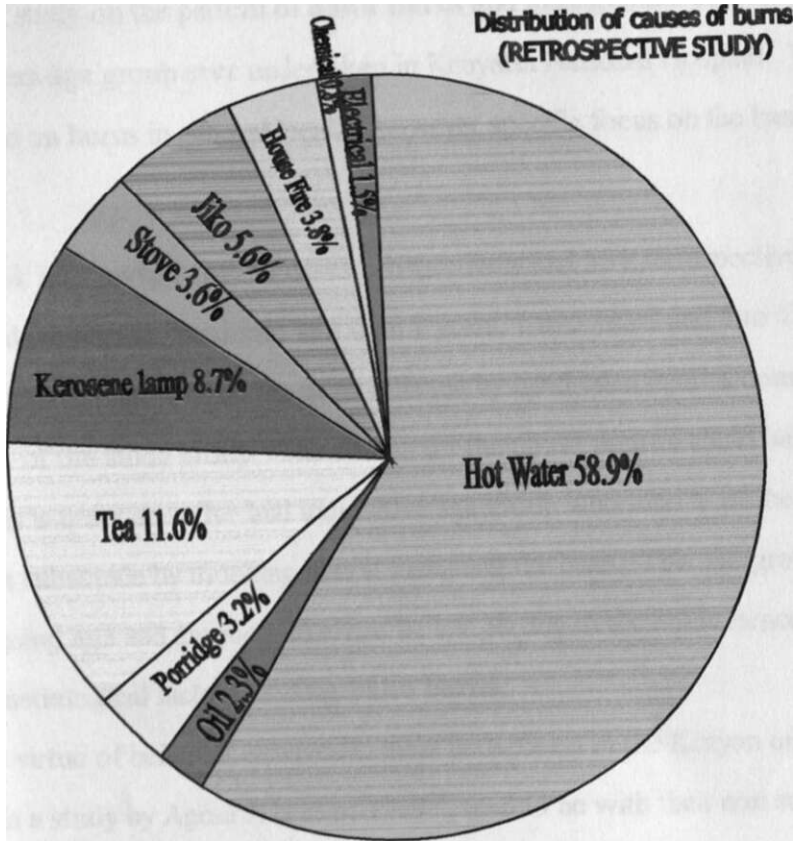
Table shows that most hand burns were managed conservatively 61.8% (**70.1%**)

TABLE 11**N. OUTCOMES AFTER MANAGEMENT OF HAND BURNS IN KNH**

	FREQUENCY	%	FREQUENCY	%
INFECTIONS	6	17.6	54	10.2
CONTRACTURES	1	2.9	25	4.7
AMPUTATION	2	5.9	11	2.1
KELOIDS / SCARS	0	.	3	0.6
HYPERTROPHIC SCARS	2	5.9	9	1.7
JOINT DEFORMITY	2	5.9	8	1.5
NO COMPLICATIONS	21	61.8	421	79.3

Table shows that most hand burns developed no complications with the various management modes in KNH 61.8% (79.3%)





DISCUSSION

Red for retrospective figures.

This is the first study on the pattern of **hand burns** and management outcome in children over 0 - 13 years age group ever undertaken in Kenyatta National Hospital. Various studies have been done on burns in general locally, however specific focus on the hand has not been considered.

This study took into perspective 34 cases prospectively and 531 retrospectively. The age group covered was categorized into less than 1 years, 1 to 5 years and 5 to 13 years. The 1 - 5 year age group was shown to be the most affected by hand burn injuries constituting upto 67.6% (75%) of the study group. The reason for the above picture could be explained in the sense that this is quite an active and inquisitive age group who tend to probe various things including hot substance by touching hence sustaining the burn. This age group are also under the school going age and are most likely to be left playing in the house hence liable to get exposed to aetiological factors causing **hand burns**.

Mothers by virtue of being housewives in most households in the Kenyan urban set-up as confirmed in a study by Agesa J. et al of 1999⁴⁸, tend to be with their non school age going child most of the day will most likely be around when burns injuries occur. In this study as shown on tables 3 mother were found to be most likely person to bring the children to hospital making upto 67.6% (53.3%) of cases.

In a study at King Fahad Hospital, Saudi Arabia in 1997, 277 patients were followed up and it was found that upto 87% of burns occurred in the domestic set-up with the majority occurring in cooking areas. In our study most **hand burns** occurred in the kitchen 73.5% (63.3%) followed by the bathroom as shown on table 4. Very few cases occurred in other places. The kitchen being mainly a cooking area is where there is a higher exposure to circumstances that can lead to burns e.g. hot water boiling in open containers, open flames.

A study done in Italy specifically focusing on **hand burns** showed a male preponderance

25

22 23 24,25

(60.48) . The same picture occurred in other studies covering burns in general . The explanation for this kind of picture was that male children tended to be more aggressive and inquisitive hence they sustained burns more frequently than female children. However in this

study the sex distribution was found to be equal both in the prospective and retrospective study.

In distribution according to whether area of residence of reported burns injury was either rural or urban it was noted that urban areas had higher incidences 76.5% (90.6%) than rural areas 23.5% (9.4%), this could be due to the changes in migration patterns with more people migrating to urban centers thus resulting in congestion of residential areas and lack of enough playing space outside⁴⁹: children thus tend to play within the house where they are more likely to sustain burns injuries as it has been shown previously that most burns injuries are domestic^{23 30}. However given that KNH is in the center of a big city, most cases would be from the urban set-up while cases occurring in rural areas end up being managed in rural health facilities unless serious enough to require referral. The study revealed the likelihood of a child sustaining a hand burn injury increased with the number of children in the family, peaking at 3 children 32.4% (34.6%). Other studies have also shown that the higher the number of children in a family the more likely the incidences of burns injuries⁴⁵. This could be due to the increase level of playfulness that occurs when there are a large number of children in a household and the inability to keep close tabs on all of them. However in this study, high levels (23.5%) was also seen in families with only one child. This kind of picture could not be explained and may require further investigation. Considering that in the retrospective data only 4.7% cases occurred in the same category.

Upto 97.5% (93.6%) of hand burns cases in this study were accidental, there was only one case reported in the prospective study, however in this situation it was as a result of arson whereby spouse set house on fire. Previously incidences have been reported in the media where parents or guardians burn hands of children because they have stolen money or done other mistakes, however during the prospective study period I never came across such cases. It thus appears that the incidence of hand burns due to child abuse is still not common locally as compared to the more developed countries where various studies have given figures of upto 20%^{26,31}. Most of these abuse related injuries occur in children less than 3 years of age and are scald or contact burns³¹, most of these abused children live in poverty in house holds headed by a young single parent with two or more children. Parental behaviours are often prompts to suspect child abuse. Abusive parents usually do not volunteer information about

the cause of injury, and are frequently evasive or contradictory when questioned about the circumstances. They rarely demonstrate guilt or show remorse and display little or no concern about the injury, its treatment or prognosis. The presence of any of these indicators should elicit suspicion of child abuse ²¹.

The study shows that hot liquids are the commonest cause of hand burns in children in KNII. Table 5 shows 70.6% (**76.0%**) were due to hot fluids followed by flame burns 26.5% (**21.7%**). These findings do not seem to be different from data found by other authors ^{24,25,31}. Of the hot liquid burns boiling water made up the highest proportion of cause of burns constituting 58.8% (**58.9%**) of the total hand burns cases as shown on Table 5 and in the pie charts, this proportion as we noted is even higher than those sustained as a result of all flame burns. Of the flame burns those caused by kerosene lamp were the commonest as shown on Table 5. Electrical and chemical burns seem to be very rare in our setup as per this study. There were no chemical burns, while electrical burns constituted only 2.9% (1.5%) of the total cause of burns in this study age group. Hot water burns could be more common in this set up because of the use of open containers (sufurias) to boil water for bathing or washing utensils. As this mainly happens in the kitchen it can also explain why as shown on the previous discussion most burns are sustained in the kitchen environment.

The study showed that most children sustained superficial hand burns 50% (**81.7%**) followed by partial thickness 44.1% (12.1%), secondly most injuries involve both dorsal and palmar aspects of the hand 58.8% (**76.6%**). Considering that most hand burns in children were due to hot liquid 70.6% (**76.0%**) and in most cases they were as a result of immersion, it appears that most of the liquids were not very hot or the immersion time was very short thus the degree of burns in terms of depth was not severe.

Superficial and partial thickness burns normally heal well with conservative management of silver sulphadiazine and occlusive dressing ^{17,34,36-38} burned hands are cleaned daily with a mixture of water and chlorhexidine gluconate. Partial thickness are managed with one percent (1%) silver sulphadiazine, suitable non-adherent dressings can also be used. These injuries should normally heal within one week hence considering that in our study over 90% of hand burns were partial thickness it is expected that the outcomes would be satisfactory with no debilitating sequelae.

This study also revealed that most children who sustained hand burns were brought to hospital within the first 24 hours 76.5% (89.1). This is comparable to other studies e.g. Nigeria study done over a ten (10) years period³¹ which showed that 79.2% of the patients presented to hospital within 24 hours. This further strengthens the argument that most of our hand burns injury patients should have acceptable outcomes as they present to hospital before sepsis sets in. In this study only 14.7% of patients presented after two (2) days; of the five patients followed up in this category three (3) were actually referrals from peripheral hospitals where they had presented within the first 24 hours as per their referral letters.

The study showed that most hand burns were managed conservatively 61.8% (70.1%). After the initial resuscitation and tetanus immuno-prophylaxis the conservative method used was mostly silver sulphadiazine and occasionally sofratulle dressing. Patients also underwent several sessions of hand physiotherapy. Systemic antibiotics were rarely used unless there was signs of serious wound infection and fever. Surgical procedures performed on these patients included escharotomy 17.6% (12.2%), surgical debridement 11.8% (2.8%) and skin grafting 8.8% (10.5%). Skin grafting, was done mostly after 14 days, early wound excision and grafting was hardly ever done. Studies have shown that early wound excision and grafting improve outcome^{27,40,41,42}, with upto 91.5% functional recovery being achieved. Further more this functional recovery is achieved over a shorter period of time as compared to the more conservative conventional methods⁴⁰.

In terms of management outcomes of hand burns in KNH, table 16 shows that majority of hand burns heal with no complication 61.8% (79.3%). However infections still appear to be quite common during the management of burns in KNH. Burns infections are managed by use of topical antimicrobials e.g. silver sulphadiazine mafenide etc, pus swabs should be taken immediately for culture and sensitivity and systemic antibiotics started once results are available. Other complications with permanent sequelae, which were observed included Contractures 2.9% (4.7%), amputations 5.9% (2.1%), Hypertrophic scars 5.9% (1.7%), joint deformities 5.9% (15%) these complications would be reduced by the practice of early wound excision and grafting^{27,40,41,42}. Hypertrophic scars are managed by use of compressive garments. A local study has shown that this kind of therapy resulted in a 50% improvement in outcome; it thus advocates pressure therapy as an adjunct measure for all

cases of hypertrophic scarring- this has been shown to be also the case in studies elsewhere^{51,52}.

CONCLUSIONS

- Most children who sustained hand burns were in the 1-5 year age group, and the male to female ratio was noted to be 1:1.
- Hand burns were more likely to occur in children coming from families with three or more children.
- The kitchen was the most likely place where a burn injury was sustained and in this area most hand burns were as a result of hot liquids e.g. water, tea etc.
- Most burn cases were accidental; we had no cases of burns implicated as a result of child abuse.
- Most burns of the hand were immersion burns affecting the right hand more than the left hand and in most cases affected both dorsal and palmar aspect of the hand.
- Most hand burns were partial thickness burns, these were mainly treated conservatively. The main modes of conservative treatment during this study period were silver sulphadiazine and occlusive dressing.

Surgical management of hand burns was not practiced consistently. In this study very few cases required Escharotomy 17.6 % (12.2 %). It also came out that early excision and grafting was hardly ever practiced.
- Most hand burns in children recovered with no complications, however of the ones that developed complications, infection was the commonest. Other complications with permanent sequelae noted were contractures 2.9 %, Amputations 5.9 % and Hypertrophic scars 5.9 %.

RECOMMENDATIONS

- I) It is important to establish a uniform management protocol for all health personnel involved in care of children with hand burns at a national level.
- II) Children's burns units should be set up so that it is easier to identify and manage Children with burns in special areas like hand, genitals face, perineum, feet.
- III) Plastic surgeons should be encouraged to manage Hand Burns more actively by excising and grafting burns wounds at the earliest opportunity to prevent long term incapacitating complications like contractures, keloids and joint deformities.
- IV) Establishment of regional specialized units with well-trained personnel, adequate funding and a more aggressive approach to management; with increasing resort to early surgery will enhance improvement in morbidity.
- V) Preventive measures should be put in place with health education targeting the vulnerable groups of persons safety measure must also be put in place.

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APPENDIX I

DATA COLLECTION FORM

I) IDENTIFICATION

- i) Serial No
- ii) Name
- iii) Hospital No
- iv) Date of Admission.
- v) Date of Discharge..

II) SOCIO-DEMOGRAPHIC CHARACTERISTICS OF PATIENT

AGE.....YEARS

SEX.....MALE [] FEMALE f []

RESIDENCE.....URBAN [] RURAL []

FAMILY SIZE.....1 [] 2 [] 3 [] 4 [] OTHER []

III) PARENTAL STATUS

- | | | | |
|----------------------------|-----|-----------------|-----|
| i) Single parent (mother) | [] | iv) Step mother | [] |
| ii) Single parent (father) | [] | v) Both parents | [] |
| iii) Stepfather | [] | vi) Orphan | [] |

IV) MENTAL STATUS

- i) Normal []
- ii) Handicap

V) PERSON BRINGING CHILD TO HOSPITAL

- | | | | |
|---------------|-----|-------------|-----|
| i) House-help | [] | iii) Mother | [] |
| ii) Father | [] | iv) Sibling | [] |
| V) Other | | | |

d) Electrical

- i) Low voltage (household 120 - 440v) []
- ii) High voltage 440-1000v []
- iii) High tension >1000v []
- iv) Other

e) Radiation

- i) Sun []
- ii) Heaters []
- iii) Welding activities []
- iv) Other []

VIII) PRESENTATION OF BURNS

a) Depth of burns injuries

- i) Superficial []
- ii) Partial thickness []
- iii) Full thickness []

b) Extent of burns injuries.....%

c) Location of burns

- i) One hand only Right [] Left []
- ii) Both hands only []
- iii) Hands as part of wider burns;
 - Left []
 - Right []
 - Both []

d) Clinical types of hand burns;

- i) Dorsal side
 - Dorsal hand []
 - Dorsal hand + fingers []
- ii) Volar side
 - Palm []
 - Palm + Fingers []

e) **No of days before presentation after injury.**

0 Presence of inhalation burns YES [J] NO []

g) **Mortality** YES [] NO []

IX) MANAGEMENT MODES

a) Conservative management

Dressings []

Topical antimicrobials

Silver sulphadiazine [] Bacitracin []

Mafenide [] Others []

b) Surgical management

i) Escharotomy []

ii) Surgical debridement []

iii) Excision and grafting within 14 days []

iv) Excision and grafting after 14 days []

v) Other

X) COMPLICATIONS

i) Infections [] iv) Keloids/scarring []

ii) Contractures [] v) Hypertrophic Scars []

iii) Amputation [] vi) Joint deformities []

vi) Other _____



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Ref: KNH-ERC/01/2227

Date: 23 April 2004

Dr K Odhiambo
Dept of *Surgery*
Faculty of Medicine
University of Nairobi

Dear Dr Odhiambo,

RESEARCH PROPOSAL "HAND BURNS IN" CHILDREN: STUDY ON THE PATTERN OF PRESENTATION AND SHORT TERM MANAGEMENT OUTCOMES AS SEEN AT KENYATTA NATIONAL HOSPITAL--_____

This is to inform you that the Kenyatta National Hospital Ethics and Research Committee has reviewed and **approved** the revised version of your above cited research proposal for the period 23 April 2004 - 22 April 2005. You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given.

On behalf of the Committee, I wish you fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of a database that will be consulted in the future when processing related research study so as to minimize chances of study duplication.

Yours sincerely,

PROF. A N GUANTAI
SECRETARY, KNH-ERC

Cc Prof. K Bhatt, Chairperson, KNH-ERC
The Deputy Director (C/S), KNH
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