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Crush injuries of the hand^{**}

L. I. OKEKE, D. DOGO, J. K. LADIPO and O. G. AJAO
College of Medicine and University College Hospital, Ibadan, Nigeria.

Abstract

A retrospective review of 58 patients presenting with crush injuries of the hand within the 6 year period April 1984 to March 1990 was undertaken. The male female ratio was 3:1, with a mean age of 25.13 ± 15.1 years. The peak incidence was in the 3rd decade of life. Machines (55.17%) were the commonest cause with the pepper grinder featuring most prominently.

The dorsum (60.3%), little (55.1%) and ring (53.5%) fingers of the right hand were the most commonly involved. Most of the injuries were multiple. Management was mainly conservative and entailed initial limited debridement, thorough washing with soap and water under adequate anaesthesia, bulky boxing glove dressing, elevation, antibiotics and early hand physiotherapy with late reconstruction. Results were excellent in 13 (22.41%), good in 19 (32.76%) poor in 23 (39.66%) and unknown in 3 (5.17%) who were lost to follow-up. Our poor result is perhaps the warning signal that we should abandon our extreme conservative stance and be more aggressive in our attitude to these injuries.

Résumé

On a fait un revue rétrospectif de 58 patientes qui ont eu des mains écrasées dans une période de 6 années (Avril 1984 à Mars 1990). Le rapport mâle - femelle était de trois pour un et l'âge moyen des patientes était 25.13 ± 15.10 ans. Ici on a trouvé que la plupart des accidents ont eu lieu dans la troisième décennie de la vie (des blessés). Les machines étaient les causes les plus fréquentes (à l'environ de 55.17% des cas). Le moulin à piment était la plus prédominantes de ces machines.

Le doigt dorsal (60.34%), l'auriculaire (55.17%) et l'annulaire (53.45%) de la main droite étaient les doigts les plus affectés. La plupart des lésions

étaient multiples. Le traitement était, en grande partie, conservatif, constituant un débridement limité, un nettoyage à fonds avec de l'eau et du savon (et sous l'anesthésie adéquate), de gros pansements en forme des gants de boxe, l'élévation, les antibiotiques et la physiothérapie de la main avec une reconstruction tardive. Les résultats obtenus dans 13 patientes (22.41%) étaient excellents, bons dans les cas de 19 patientes (32.76%), pauvres dans les cas de 23 patientes (39.66%) et inconnus chez 3 patientes (5.17%) qui ont été perdus lors de la recherche. Les mauvais résultats obtenus sont peut-être un signal d'avertissement que nous devons abandonner notre position conservatrice extrême et être plus agressifs dans notre traitement des lésions.

Introduction

In our attempt at stock-taking, we decided to look at crush injuries of the hand to determine the pattern of injury, their management and how well they have fared under us in the six year period ending March 1990.

Materials and method

There were a total of 113 patients with hand injuries. Sixty-two of these were entered as crush injuries. The case notes contained enough information in 58 of these patients and form the basis of this analysis.

The analysis included the age, sex, socio-economic status, hand dominance, hand involved, cause of injury, the nature and extent of the injury, the presence of associated injuries, time interval between injury and presentation, the method of management and outcome of management.

Findings

Fifty-eight patients were studied. There were 44 males and 14 females with a male : female ratio of

* All correspondence to Dr. L. I. Okeke (MBBS, FWACS),
Department of Surgery, University College Hospital, Ibadan.

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3:1. Their ages ranged from 5-60 years with a mean of 25.1 ± 15.1 years. The age distribution is as shown in Table 1. Majority of these patients were in the first 4 decades with a peak incidence in the 3rd decade. Forty-three (74.1%) were from the low socio-economic class, 14(24.1%) and 1 (1.7%) from the middle and upper classes respectively. Machines were the commonest cause of these injuries (Table 2). The pepper grinder was the commonest injuring machine (Table 3). The right hand was more commonly involved alone (Table 4). Of the 11 patients for whom hand dominance was documented, 10 were right handed while one was left handed. The dominant hand was involved in 5(8.6%) while the non-dominant hand was involved in 6(10.3%). In 47(82.0%) the hand dominance was not stated.

Table 1: Age Distribution

Age Range	No	%
0 - 9	11	19.0
10 - 19	12	20.7
20 - 29	15	25.9
30 - 39	10	17.2
40 - 49	4	6.8
50 - 59	3	5.2
60 - 69	3	5.2
Total	58	100%

Table 2: Cause of Injury

	No.	%
Machine	32	55.2
RTA	9	15.5
Heavy object	13	22.4
Gun shot	4	6.9
Total	58	100%

Table 3: Types of injuring machine

	No.
Pepper grinder	17
Cassava grinder	3
Bread machine	4
Working implement	8
Total	32

Table 4: Hand involved

	No.	%
Rt. hand alone	30	51.7
Lt. hand alone	24	41.5
Both hands	4	6.8
Total	58	100%

The dorsum of the hand was more commonly involved than the palm. The little and the ring fingers were the most commonly involved fingers (Table 5). The skin 57(98.3%) was the most commonly involved tissue. Most of the injuries were multiple (Table 6).

Table 5: Parts of the hand/fingers involved

	No	%
Dorsum	35	60.3
Palm	22	37.9
Thumb	16	27.2
Index	26	44.4
Middle	24	41.5
Ring	31	52.7
Little	32	54.4

Most injuries were multiple

Table 6: Tissues of the hand/fingers involved

	57	98.3%
Skin	57	98.3%
Tendon	46	78.8
Nerves	29	49.3
Major blood vessels	28	47.6
Distal phalanx	24	40.8
Middle phalanx	16	27.2
Proximal phalanx	14	24.0
Metacarpals	13	22.4
Carpals	2	3.4
Joint dislocation	6	10.4

Most of the injuries were multiple

Associated injuries of the forearm occurred in 8(13.7%) leading to fracture of the radius alone in 2(3.4%) and radius and ulnar in 5(8.6%). Eighteen (30.9%) patients presented after 8 hours of injury with their wounds already showing gross evidence of infection.

Management

All the cases with devitalized tissues and foreign body contamination were managed by initial limited debridement and thorough wound washing with soap and water under adequate anaesthesia, bulky dressings with the metacarpophalangeal joints flexed to 90° and the interphalangeal joints fully extended and hand elevation. Associated fractures of the proximal and middle phalanges were managed by internal fixation with Kirschner wire in 6(10.3%) and by closed reduction in 8(13.8%). In 39(67.2%) cases

in whom the injury to the skin was not severe, loose primary closure was done (Table 7). Antibiotics were exhibited in 53(91.3%) cases while all 58(100%) received anti-tetanus prophylaxis. Intravenous fluids were required for severe blood loss in 10(17.24%) and primarily because of associated head injury in 3(5.2%).

Table 7: Management procedure

Management Procedures Carried Out	No.	%
Initial debridement	48	(82.75)
Elevation	50	(86.20)
Primary wound closure	39	(67.24)
Delayed primary wound closure	1	(1.72)
Delayed skin grafting	3	(5.16)
Primary tendon repair	8	(13.76)
Delayed tendon repair	3	(5.16)
Delayed nerve repair	2	(8.44)
Skin flap would coverage	1	(1.72)
Closed reduction of #	8	(13.76)
Open reduction of #	6	(10.32)
Antibiotics	53	(91.16)
Tetanus toxoid	52	(89.44)
Antitetanus serum	41	(71.52)
IV fluids	13	(22.36)
Admitted	28	(48.16)

Twenty-eight patients (48.3%) required hospitalisation for periods ranging from 1 to 119 days — with mean hospital stay of 8.5 ± 20.27 days.

Definition of outcome of management

The outcomes were regarded as excellent if there was minimal scarring without any limitation of function; good if there was some scarring with mild limitation of function which does not bother the patient, and poor if there was scarring and or loss of parts or whole of the hand with sufficient limitation of function to interfere with patient's normal activities.

The result of management was excellent in 13(22.4%), good in 19(32.8%), poor in 23(39.7%) and unknown in 3(5.2%) who were lost to follow-up. The patients were followed up for periods ranging from 0-106 weeks with a mean of 11.8 ± 18.4 weeks. None of the patients died.

Discussion

Extremely few hand injuries result in death but they cause untold loss to the injured, his family, his employer and his fellow citizen. The sole purpose of

the surgery of the hand is to restore function and this has absolute priority over restoration of appearance. Crush injury wounds of the hand are difficult to close because of swelling and oedema, and are notorious for the degree of scar contracture and tendon fixation which follow[1].

The male predominance and peak incidence in the third decade of life are in agreement with the findings of Adeyemi-Doro 1988[2] at the Lagos University Teaching Hospital (LUTH). Thus the very active population of males in their 3rd decade of life are at risk and get exposed to road traffic accidents and injuries from machinery in their pursuit of livelihood for their families. However, unlike the findings of Adeyemi-Doro[2] whose patients' injuries were mainly located on the thumb, index and middle fingers, most of our injuries were on the little and ring fingers of the right hand.

Due to a combination of late presentation and our traditional non-aggressive stance, we have tended to be very conservative in the management of our crush injuries of the hand.

The scars resulting from injuries to the skin of the dorsum of the hand in 60.3% of our patients have in general yielded to intensive physiotherapy. Most of our poor results are due to varying degrees of loss of volar skin, intrinsic muscles of the hand and unyielding contractures of scars of volar injuries.

Chow *et al* 1988[3] had noted similar results among their patients with thenar injuries managed before 1978 by the conservative method of leaving tissues of doubtful viability, waiting for gangrene or definite demarcation which took on the average about 1-2 weeks. During this waiting period, the tissues had undergone progressive necrosis, infection and scarring, factors believed to have contributed to their poor results. They have since then adopted the regimen of radical debridement of muscle, subcutaneous tissue and skin when in doubt concerning viability, rigid Kirschner wire or mini-plate bone fixation, immediate skin cover mostly by groin or lower abdominal flaps, maintenance of the first web space with K-wire, rigorous post-operative mobilisation and late reconstruction.

Provision of adequate soft tissue coverage for difficult hand wounds remains a challenging problem especially where vital structures such as bone, tendon, nerves and blood vessels are exposed[4]. The groin or abdominal flaps as advocated above by Chow *et al* 1988[3] have their limitations which

include immobilisation in dependent position for several weeks, difficulty with initiation of early hand physiotherapy, the need for second operation for division of the pedicle and bulkiness that often requires additional defatting procedures.

Logan *et al* 1988[4] were able to salvage and reconstruct difficult hand injuries using free anterior muscle transplantation. The advantage of this over the traditional flap techniques is that the high vascularity of muscle transplants provides ideal coverage for devitalized and infected wounds, and allows for early mobilisation and elevation[4]. The disadvantage, however, is that the procedure is complicated, requiring microsurgical anastomosis of the blood vessels and nerves of the transplant to the recipient blood vessels and nerves respectively. To overcome this, Soutar *et al* 1984[5] among other workers, have advocated and used the radial forearm flap in the management of severe soft tissue injuries of the hand. The radial forearm flap makes tissues readily available locally and offers a simple and effective one stage method of soft tissue reconstruction. Surgery is confined to a single limb, permitting early mobilisation and rehabilitation.

We are aware that many useful charts and guidelines to estimate loss of function have been prepared by compensation and insurance companies and by surgeons themselves, notable among whom are Kessler and the American Academy of Orthopaedic Surgeons[6].

Separate components of the disability, each of which may be expressed as a percentage loss of function, cannot be simply added together, the one disability often compounding the other[1].

Most of our injuries were multiple and we found these charts rather unsuitable for our purpose. We have therefore based our main thrust on the patient's own subjective assessment of the usefulness of his hand. Most workers may frown at this but we would

like to join Rank *et al*[1] in reminding us that in relation to his work and day by day activities, no one knows better than does the patient himself the order of his handicap.

Our poor result is perhaps the signal that we should abandon our extreme conservative stance and be more aggressive in our attitude to these wounds, utilizing flaps and/or microvascular surgical techniques when these are indicated.

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