Traumatic extremity amputation in a Nigerian setting: patterns and challenges of care

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Abstract

Purpose We aimed to determine the epidemiological pattern and highlight challenges of managing traumatic amputation in our environment.

Method This was a ten-year retrospective study of all the patients with traumatic extremity amputation seen in Ebonyi State University Teaching Hospital and Federal Medical Centre Abakaliki from January 2001 to December 2010.

Result There were 53 patients with 58 amputations studied. There was a male to female ratio of 3:1 and the mean age was 32.67 ± 1.54 years. Amputations were more prevalent in the rainy season. Road traffic accident was the predominant causative factor and accounted for about 57% of amputations. A majority of the patients (81.4%) had no pre-hospital care and none of the amputated parts received optimum care. Three patients underwent re-attachment of amputated fingers and one was successful. Wound infection

(in 56.6% of patients) was the most common complication observed. Overall mortality was 7.5% and all were due to complications of amputations.

Conclusion Appropriate injury prevention mechanisms based on the observed patterns are needed. Educational campaigns for prevention should be intensified during the rainy season and directed toward young men. Measures aimed at improving pre-hospital care of patients and optimum care of amputated parts is an important aspect to be considered in any developmental programme of replantation services in the sub-region.

Introduction

Traumatic extremity amputation is a component of morbidity associated with trauma in developing nations although it is under reported. The sudden and unexpected loss of part of the extremity to trauma (without going through a pre-loss adaptation phase) is a devastating condition.

The aetiological factors and mechanism of extremity amputation injuries vary between and within countries depending on prevailing cultural and geo-political conditions. In developing nations, machetes are available in many homes for domestic and farming purposes. Accidental or intentional machete injuries can cause extremity amputation [13]. Lawnmower injuries causing extremity amputations are common in regions where lawnmowers are readily available [15, 16]. Gunshots, landmines, fireworks and other forms of explosives used in war or terrorist attacks could cause amputation [5, 6, 18]. Road traffic accidents, occupational injuries and natural disasters are all possible causes of extremity amputation [2, 12].

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Traumatic extremity amputation may be sharp (guillotine), crushed, avulsion type or a combination of types depending on the mechanism of injury [19]. Impressive development in microsurgical technique and skills, prosthetic designs and rehabilitation have significantly improved long-term outcome for amputees [20].

In a developing nation such as Nigeria, there is a paucity of centres with a capacity to provide adequate care and rehabilitation for this unfortunate group of patients [21, 22]. Those amputees who survive injury are often left with enormous physical and psychological challenges [22].

Limited data on traumatic extremity amputation in our sub-region necessitated this study.

The aim of this study was to determine the patterns and highlight challenges of managing traumatic extremity amputation in a Nigerian setting.

Patients and methods

This was a retrospective study of all patients with traumatic extremity amputations seen at Ebonyi State University Teaching Hospital and Federal Medical Centre Abakaliki from January 2001 to December 2010. Both are tertiary health institutions in Abakaliki, and they serve a population of 8 million persons and care for most trauma patients. With the permission of our Hospital Ethical and Research Committees case notes of patients were used as the source of data. Information such as demographic data, aetiology and mechanism of injury, the month of the year injury occurred, length of time between injury and presentation to the hospital, pre-hospital care, level of severance, care of the amputated part, associated injuries as well as treatment, outcome and complications, was extracted from the patient case notes.

Optimum care given to complete amputated part was considered adequate if it was wrapped in saline soaked gauze, placed in a plastic bag and then placed on ice or ice water.

Optimum care was given to partial amputation if it was splinted and saline moistened sterile dressing was placed over exposed tissue to reduce additional contamination. Any variation from the above two definitions was regarded as suboptimal care.

Cases of trauma-related amputation without partial or complete severance of the extremity at the scene of trauma, cases of gangrene complicating poorly managed simple or open injuries of extremity by either orthodox medical practitioners or traditional bone-setters (bone-setters gangrene) and those with incomplete information in their case note record were excluded from this study.

Data analysis was done using Statistical Package for Social Sciences (SPSS) version 16 and Quantitative Skills software (SISA tables) from the SISA website at

<http://www.quantitativeskills.com/manual/tablesman.htm>. Frequency tables, cross tabulation, Fisher's exact test and Pearson's chi square test of significance were used. For all statistical analysis a *p* value <0.05 was considered significant.

Results

Within the ten-year period 53 patients presented with 58 amputations. There were 29 (50%) major and 29 (50%) minor amputations in 28 and 25 patients, respectively.

There were 40 males and 13 females, and the male to female ratio was 3:1. In the females affected, eight (61.5%) were single and five (38.5%) were married. In the affected males 16 (40%) were single and 24 (60%) were married.

The ages ranged from seven to 85 years with a mean of 32.67 ± 1.54 years and a median of 30 years.

Work related (occupational) injury accounted for amputations in 15 patients (28.3%) whereas non-occupational injury accounted for amputations in 38 patients (71.7%).

About 20 patients (37.7%) had amputation during the dry season (months of November to April in southeast Nigeria). About 33 patients (63.3%) had amputations in the wet/raining season (months of May to October). Cases of amputation were more prevalent in the months of September and June with a frequency of nine (17%) and eight (15.1%) cases observed, respectively.

Road traffic injury accounted for amputation in 30 patients (56.6%), industrial machine and machete injuries accounted for seven (13.2%) and five (9.4%) cases, respectively, as shown in Fig. 1.

In the road traffic injury group, 15 patients (50%) were involved in a motorcycle crash, 13 patients (43.3%) in a motor vehicle accident and two patients (6.7%) in pedestrian injury. In the months of June and September, RTI

Fig. 1 Aetiology of traumatic extremity amputation

accounted for 62.5% and 44.4% of cases recorded, respectively.

Interpersonal violence and accidental injury accounted for 60 and 40% of machete related amputation, respectively. Industrial machine injury in a cassava processing factory accounted for four major amputations in three patients who were pulled in and injured by machines when their clothing became caught (one of them had a bilateral below knee amputation). Each of the machine injuries in concrete block, quarry, asphalt, and poultry feed industries accounted for one amputation. Gunshots from armed robbery attacks accounted for amputation in three patients. Landmines, tear gas canister and gun powder contributed one patient each in the explosion related amputations.

Crush type of amputation was observed in 34 (64.2%) patients whereas guillotine type was observed in 19 (35.8%) patients.

The mean and median length of time between injury and arrival to the hospital was 98.8 and six hours, respectively. Twenty-seven patients (60%) presented within one to six hours of injury and 21 patients (39.6%) presented after 24 hours of injury (Table 1). A statistically significant proportion of guillotine amputations (73.7%) presented within one to six hours of injury ($p = 0.000$). Amputation by crush injury mechanism accounted for 90.5% of the patients presenting after 24 hours as shown in Table 1.

The lower extremity was involved in 27 patients (50.9%). The upper extremity was affected in 26 patients (49.1%). Major amputation was significantly located in the lower extremity and accounted for 21/29 or 72.4% of amputations in the anatomical region (Fisher's exact test, $p = 0.000$). Minor amputation was significantly located in the upper extremity and accounted for 22/29 or 75.9% of amputations in the region (Fisher's exact test, $p = 0.000$).

In males, 25/44 or 56.8% of amputations were located in the upper extremity and 19/44 or 43.2% in the lower extremity. Amputations in females were significantly located in the lower extremity when compared to males (Fisher's exact test, $p < 0.05$) as shown in Fig. 2.

There were 33 (62.3%) partial and 20 (37.7%) complete amputations. The amputated parts of 21 patients (39.6%) were not seen in hospital at the time of presentation. Eleven patients (20.8%) presented with gangrenous amputated parts.

Table 1 Traumatic amputation by form and injury arrival time interval

Time interval	Crush, <i>n</i> (%)	Guillotine, <i>n</i> (%)	Total, <i>N</i>
1–6 hours	13 (38.2)	14 (73.7)	27
7–24 hours	2 (5.9)	3 (15.8)	5
>24 hours	19 (55.9)	2 (10.5)	21
Total, <i>N</i> (%)	34 (100)	19 (100)	53

Fisher's exact test ($p = 0.000$)

Fig. 2 Amputation by gender and anatomical site

There were associated injuries on admission in 20 (37.7%) patients. Associated injuries in 11 of them were soft tissue injuries (5) and fractures of femur (5), radius (2), ulna (1), and pelvis (1). Nine patients (17%) had multiple injuries. Road traffic accidents accounted for eight patients (88.9%) with multiple injuries.

A majority of the patients 44 (83%) had no pre-hospital care. The care given to amputated parts was suboptimal in 100% of patients.

All the patients were received and given adequate resuscitation in the Accident and Emergency Unit of the hospitals. All patients had wound debridement, normal saline lavage, anti-tetanus and antibiotic cover. Stump refashions and revision was the definitive treatment in a majority (70%) of the patients (Fig. 3). Three patients (5.7%) had a reattachment of amputated fingers, and five

Fig. 3 Treatment of amputations

patients (9.4%) had wound debridement and lavage only (three of them died before the second stage of surgery and two discharged themselves against advice) (Fig. 3). Successful outcome was observed in one of the three patients who had reattachment of an amputated finger part.

There was amputation stump wound infection in 30 patients (56.6%). Haemorrhagic and septic shock were complications in six (11.3%) and five (9.4%) patients, respectively (Table 2). Wound infection was significantly related more to amputations by crushing mechanism than the guillotine type (Fisher's exact test, $p < 0.001$). About 81% (17/24) of patients who presented to the hospital later than 24 hours had stump wound infection whereas about 48% (14/27) of patients who presented within six hours of injury had wound infection. The five amputated patients who had septic shock presented to the hospital later than 24 hours after injury. Pulmonary embolism was a complication in one patient who presented with bilateral below knee amputation.

Four patients (7.5%) died, two patients (3.8%) discharged themselves against medical advice and 36 patients (88.7%) recovered. Haemorrhagic shock, septic shock, pulmonary embolism and acute renal failure were the causes of death.

The mean and median duration of hospital admission were 21 and 28 days, respectively.

Eighteen patients (34%) were referred for prosthetics assessment in another centre about 100 km away, but only four (7.5%) had prosthetic fitting.

Discussion

Traumatic extremity amputation is a component of trauma morbidity with enormous physical and psychological challenges worldwide.

The result of our study indicates that more males were affected than females. This is similar to the finding reported by other studies on trauma-related extremity amputations [12, 20].

It was observed that single females were affected more than married ones with the reverse case for males. The reasons for this observed pattern requires further study.

Table 2 Complications of traumatic extremity amputation ($N=53$)

Complications	Number of patients	(%)
Wound infection	30	56.6
Haemorrhagic shock	6	11.3
Septic shock	5	9.4
Acute renal failure	1	1.9
Pulmonary embolism	1	1.9
Total	43	81.1

The involvement of a predominantly young age group is similar to that reported for traumatic amputations in other studies [20, 22].

Road traffic injury was observed as the most common causative factor, and about 50% of amputations from road traffic accidents were due to motorcycle injury. Motorcycle injuries have been documented by previous studies to affect mainly the extremities and head region [3, 17].

The majority of machete amputation injuries we observed were due to interpersonal violence. Interpersonal violence rather than work-related or accidental injury has been documented in another previous study as the major aetiological factor of machete injury in our environment [13].

The mechanism of amputation injury we observed in a cassava processing plant suggests lack of stringent adherence to safety precautions. The greater prevalence of traumatic amputation in the months of June and September we observed in the temporal distribution of cases is similar to the finding by Nasser et al. in Iran [12]. The majority of patients who presented to the hospital after 24 hours of injury had crush forms of amputation whereas the majority of those who had guillotine amputation presented within the first six hours of injury. The exact reasons for these observations will require further study. The involvement of upper and lower extremities in almost equal proportion observed is at variance with involvement of upper extremity in 89% of cases reported by Nasser et al. [12]. The majority of amputations in Iran were occupational injuries whereas non-occupational injury accounted for the majority of the cases we studied. The differences in the anatomical distribution of amputation between this study and that of Nasser et al. could be explained by the findings reported by Kobayashi et al. [8] and Lang et al. [9]. Kobayashi et al., in a similar study in California, observed that the lower extremity amputation was more likely when the causative factor was road traffic accidents, whereas the upper extremity amputation was more likely in work-related accidents [8]. Liang et al. also reported that young male manufacturing workers were at high risk of occupational amputation of upper extremity [9].

The location of proportionately more major amputations in the lower limb than upper limb is similar to the finding in another previous study [4].

The lack of pre-hospital care observed in the majority of the patients is generally a major challenge facing trauma care in developing nations that other previous studies have documented [3, 11]. Optimum care of amputated parts is one of the factors that influence the outcome of reattachment or replantation [7, 10]. None of our patients' amputated parts had optimum care. Lack of optimum care of amputated parts observed in all the patients is another challenge in the Nigerian setting where ice needed for care

may not be readily available due to incessant power supply problems.

It was observed that the definitive surgical treatment in a majority of our patients was refashioning and closure of the amputation stump. Closure of the amputation stump is generally considered an easier option compared to replantation [14]. The percentage of our patients who underwent replantation is lower than the 6.9% reported by Kobayashi et al. in a similar study in California [8]. Amputation stump wound infection was the most common complication. The observed infection rate of about 57% is higher than the 48% value reported by Akinyola et al. in a study on microbiology of amputation wound infection in a Nigerian setting [1]. The difference in infection rate between the two studies is to be expected considering that in the latter about 30% were non-traumatic and 70% were trauma related amputations whereas the former were all traumatic amputations. The high wound infection rate we observed is not surprising because of degree of contamination expected for amputation that was not planned and occurred outside the hospital setting. Late presentation was also a factor that contributed to wound infections and its sequel, septic shock, observed in our study.

The mortality rate of 7.5% we observed was higher than the 3.4% value reported by Kobayashi et al. [8]. The causes of death we observed were complications of amputations whereas in the latter it was attributed primarily to associated injuries. Optimum pre-hospital care and early presentation to hospital could have prevented mortality from haemorrhagic and septic shock.

The 7.5% of the patients in our study who were able to afford prosthetic fitting is less than the 16% reported by Yinusa et al. in a study carried out in a trauma centre that has a prosthetic unit in Lagos, south-west Nigeria [22]. Non-availability of prosthetic units in our centre may be an explanation for this observed difference. The limitations of this study are that (1) it is a retrospective study and subject to problems of incomplete records and documentation and (2) it is a hospital-based study.

Conclusion

Traumatic extremity amputations in our environment occur in road traffic injuries in more than half of the cases, affecting mainly the young age group, and are more prevalent in the rainy season. Appropriate injury prevention mechanisms based on the observed patterns are needed. Educational campaigns for prevention should be intensified during the rainy season and directed toward young men.

Definitive treatment in the majority of patients was stump refashion because of challenges of care in an environment where nascent replantation services exist. Measures aimed at improving pre-hospital care of patients

and optimum care of amputated parts (such as establishment of emergency medical service care providers well trained in pre-hospital care of traumatic amputations) should be considered in any developmental programme of replantation services in the sub-region.

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Conflict of interest The authors declare that they have no conflict of interest.

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