

# MASS BURNS DISASTER IN ABULE-EGBA, LAGOS, NIGERIA FROM A PETROLEUM PIPELINE EXPLOSION FIRE

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**SUMMARY.** The aim of this paper is to review the basic principles of triage in mass burns disasters and discuss the experience of the Lagos State University Teaching Hospital (LASUTH), Ikeja, Nigeria, in the December 2006 disaster at Abule-Egba, Lagos, Nigeria. It is hoped that the experience gained will help in the planning for and management of similar disasters in the developing countries with limited facilities. Burn injury has been described as the severest form of trauma and its management is very challenging as it is often accompanied by numerous pathophysiological changes. Successful management requires expert management by well-trained personnel in equipped and dedicated centres. In mass disasters the total number of victims may exceed the capability of the facility and its staff and a system for sorting out the patients and caring for those that will benefit from the facilities available needs to be developed. Other patients will either be sent to other medical facilities for further treatment or discharged after initial care for future follow-up. Documented experiences in the management of mass burns disasters from petroleum pipeline explosions from developing countries are rare. However, petroleum pipeline explosions, especially in the Lagos area of Nigeria, are relatively common. These cases have been associated with a variety of factors. The resulting morbidity and mortality have been high. LASUTH has a dedicated burns centre, which has received and managed many burn patients. Triage is the medical process of screening patients according to their need of treatment and the resources available. The aims and objectives of triage are discussed, its various levels described, and the final goals elaborated. All the burn victims involved in the 2006 disaster were studied, together with the triage carried out at different levels and the consequent sorting of the patients. Standard burns management was carried out. A total of 385 patients sustained burns of various degrees from the fire resulting from the explosion. On site, emergency department (ED) and intra-hospital triage were carried out. Ninety patients were brought to the LASUTH ED. Of these, 51 patients (56.67%) received first-aid treatment and were either discharged for out-patient follow-up or referred to secondary health care facilities. Twenty-eight (31.11%) out of the remaining 39 patients with burns in more than 70% total body surface area (TBSA) were categorized as unsalvageable and 11 (12.22%) with less than 70% TBSA as salvageable. All the patients in the unsalvageable group died (i.e. 100% mortality), while one patient died in the salvageable group (mortality rate, 9.09%). The mortality rate for the ruptured petroleum product pipeline incident was 84.16%; the fatality rate for all patients seen at LASUTH was 32.22%. The need for caution in the handling of petroleum products is discussed and the effectiveness of the triage system used is highlighted. In conclusion, burns from flammable petroleum products can be very dangerous and proper triage should therefore be carried out, with salvageable patients being managed by experts in dedicated burns centres.

## Introduction and background information

Burn injury has been categorized as the severest form of trauma.<sup>1</sup> It is accompanied by myriads of problems.<sup>2,3</sup> When burn injuries occur in a mass disaster, the total number of patients and the severity of the injuries exceed the capability of burns facility and their staff. The incidence of burn injuries in developing countries is high. India, with a population of over one billion, records 700,000-800,000 cases of burns annually. In Ibadan, Nigeria, with an estimated population of about four million, about 100 patients with major burn injuries are admitted annually into one of the cities' tertiary hospitals.

The following factors have been associated with an elevated incidence of burn injury:<sup>1-3,5,6</sup>

a) High population density

- b) Poverty
  - c) Sociocultural factors
  - d) Vandalization/lack of petrol pipeline maintenance
  - e) Illiteracy
  - f) Perennial fuel scarcity
  - g) Adulterated/contaminated kerosene
  - h) Erratic electricity power supply
  - i) Local traditional practices, such as hot-water baths for mothers after childbirth
  - j) Alternative medical practices, such as treating convulsions in children by inserting their feet into fire
- Complicating the injuries are certain factors militating against their management. These include:
- a) Social factors
  - b) Economic and cultural factors<sup>5</sup>
- There are no effective burns prevention programmes

in Nigeria. This is due to lack of government initiative and the population's low literacy rate.<sup>4,5</sup> Equally important are certain superstitious beliefs in certain societies with regard to fire and the injuries resulting from them. There are also certain religious rituals, and social activities that are associated with fire. Fireworks are used during religious activities in various societies. When such use is not controlled, severe burns can result.<sup>7</sup> Flammable materials are used for religious rites in some societies, exposing the performers to risks of burn injury. The burns that are known to have resulted from them are believed to serve for purification purposes. Medical management is often delayed on these occasions.<sup>1</sup>

When these injuries occur, especially on a large scale, properly equipped and staffed health facilities are usually unavailable or inadequate. The need will therefore arise to sort out the patients who will benefit from whatever resources are available.

### **Principles of triage in mass burns disasters**

Disaster has been described as an unpredictable situation with injuries occurring on a massive scale and posing immediate threat to public health.<sup>4,5</sup> In burn injury disasters, there are mass burns casualties resulting from an event with accompanying loss of human lives and materials from known thermal agents.

Triage is the medical process of screening patients according to their need of treatment and the resources available.<sup>4</sup> Triage is used when conventional standards of medical care cannot be delivered to all the victims.<sup>8,9</sup> The final goal is to optimize care for the maximum number of salvageable patients.<sup>8</sup> Triage may need to be at different levels and stages.<sup>7,10,11</sup> The different levels of triage are:

- a) Pre-hospital
- b) Inter-hospital (Emergency Room)
- c) Intra-hospital

#### **a) Pre-hospital triage**

This is done at the site of the injury. The factors to be considered are:

- i) Total body surface area (TBSA) involved in the burns and the depth of involvement
- ii) The resources available
- iii) The distance between the site of the disaster and the health facility designated to treat the total number of potential patients

The bed spaces available at the designated health facility, the transportation capacity, and the time necessary to get from the site of injury to the health facility are also considered.

Triage should be performed by personnel with knowledge of burns management.<sup>5</sup>

#### **b) Hospital and inter-hospital triage**

This is performed at the designated health facility. Ideally, it should be done in a space between the ambulance bay/reception area and the Emergency Department.

Triage at this level should be prognostic and categorized in relation to:<sup>8</sup>

- 1) Age of patient
- 2) TBSA involved in the burns and the depth of tissue involvement
- 3) Anatomical sites of the body involved
- 4) Presence or otherwise of inhalation injury
- 5) Associated injuries and co-morbidity

These factors can be categorized as major, intermediate, and other.

Major factors are:

- i) TBSA
- ii) Age of patient

Intermediate factors are:

- i) Arterial oxygen saturation (SpO<sub>2</sub>) on arrival
- ii) Inhalation injury
- iii) Presence of bronchorespiratory disease

Other factors are:

- i) Source of thermal agent
- ii) Availability of resources
- iii) Consideration for mental stress and breakdown

#### *Grouping of patients*

Group I - Minor burns in non-critical anatomical parts of the body (<10% TBSA in children; <20% TBSA in adults)

Group II - Minor burns in specialized/critical areas, i.e. face, hand, genitalia, flexor surfaces

Group III - Major burns (10% in children; 20-60% in adults)

Group IV - Extensive burns (>60% TBSA)

Group V - Minor burns with inhalation injury or other associated injuries

#### **Order of evacuation from the Reception Area**

Batch One - Groups III and V

Batch Two - Group II

Batch Three - Group I. These patients should be given first-aid treatment, including tetanus prophylaxis, and referred to primary or secondary care centres for follow-up treatment.

The patients in groups III, V, II, and I are the salvageable patients, especially in the developing countries with limited resources for burns management.

Group IV patients are in the lowest priority for evacuation and transfer. These patients are mostly unsalvageable, considering the crisis situation and the facilities available in most health facilities in developing countries.

#### *Management procedures at the designated health facility*

Group II patients may require a short hospital stay, special wound care, or operative procedures later.

Group III patients require admission to dedicated burns units or centres for intravenous fluid resuscitation, adequate wound care, and various surgical procedures. Psychiatric monitoring may be required as part of the management. Group V patients require oxygen; this may be done by the administration of oxygen-enriched air through a face mask or nasal catheter or by endotracheal intubation with assisted ventilation and close monitoring of the various physiological parameters.

#### c) Intra-hospital triage

By the end of the inter-hospital triage, patients who require management in the highly specialized areas of the High Dependence Wards and the Intensive Care Units - mostly patients in Group V and some from Group IV (burns in 60-80% TBSA) - will have been sorted out. These patients should then be evacuated from the Emergency Department to appropriate wards.

The universally accepted methods of triage are simple and reproducible and able to permit rapid commencement of appropriate management.<sup>12</sup>

The methods are all liable to both under- and over-triage.<sup>11,13</sup> An under-triage of 5% is acceptable. If this goes higher, there may be unnecessary morbidity and mortality in major burns that are potentially salvageable. An over-triage of 5% is also acceptable to minimize the number of patients who are under-triaged.

Triage can be successful only if the personnel, at the various levels, are appropriately trained and regularly upgraded. Equally important is the hospital's total preparedness to cope with mass casualty events and disasters. This requires pre-disaster planning, training, frequent rehearsals, and coordinated intensive multidisciplinary efforts.<sup>14</sup>

### **The Abule-Egba, Lagos, Nigeria experience**

**(December 2006):**

#### **Materials and method**

##### *Materials*

During the night of 25 December 2006, at about one a.m., leakages occurred in the petroleum products pipelines at Abule-Egba, a suburban part of Lagos. About 12 h later, while people were scooping premium motor spirit (PMS) leaking out of the pipes, the PMS fumes ignited and a fire explosion occurred. The people who sustained burns in this explosion constitute the materials for the present prospective study.

After about four hours, on-site triage was performed by the staff of the State Medical Emergency Services. The victims who were at the very centre of the leaking pipes area were all completely burned and given mass burial.

All the survivors were evacuated to Lagos State University Teaching Hospital (LASUTH), Ikeja. This is located about 10 km from the scene of the accident. In-hospital triage was performed in the Surgical Emergency Department (ED) of LASUTH.

The patients were assessed by the hospital burns management teams. Each team was headed by a burns specialist and patients were categorized as:

- a) Patients needing first aid and/or short hospital stay only
- b) Patients needing hospital admission and immediate care
- c) Patients needing care but not as urgently as in b)
- d) Patients who were unsalvageable

Group a) patients were treated and discharged or transferred to other secondary health facilities in the Lagos area.

Patients in groups b) and c) were admitted to the burns ward for highly dependent management, of whom three went into the critical care unit of LASUTH.

Patients in group d) were admitted to special areas of the ED for the necessary care.

#### **Steps in the therapy of hospitalized patients**

Intravenous accesses were secured in all patients admitted, including those in the unsalvageable group. Anti-tetanus prophylaxis was given and pain relieved. Supportive therapy and fluid replacement were initiated. Blood replacement was given later when necessary. Wound biopsies were taken for microbial studies and sensitivity patterns.

*Burn wound care.* Wound scrubblings were initially performed in the theatre and later in the wards. Closed wound dressings were applied to all patients.

Prophylactic antibiotics based on the ward microbial surveillance results were commenced and changed according to the wound biopsy results.

*Surgical procedures.* These included wound scrubbing, escharotomies, escharectomies, skin graftings, and subsequent contracture release.

Diagnostic bronchoscopies were performed in four patients.

Patients had regular physiotherapy.

Four patients developed acute psychiatric problems and were managed by psychiatrists, using antipsychotic drugs.

Data were collected and stored in the computer. Excel software was used to analyse the data.

#### **Results**

A total number of 385 burn patients were involved in the fire incident. All were males. Two hundred and ninety-five patients were burned beyond recognition at the epicentre of the fire explosion and taken away for mass bur-

al. Ninety patients were evacuated to LASUTH for in-hospital triage (Table I).

**Table I** - On-site triage

Patients who were completely burned/charred	295
Patients who were evacuated to LASUTH	88
Patient seen after 24 h at LASUTH	2
Total number of patients involved	385

The total number of patients who sustained burns in less than 20% not involving vital areas was 51 (56.67%). This group of patients was treated and discharged after 24 h of observation for follow-up at LASUTH or other health facilities. Thirty-nine patients (43.33%) sustained major burns in various sites, with or without inhalation injury, and were admitted to hospital (Table II).

**Table II** - In-hospital triage

Patients with minor burns not involving vital areas	51
Patients with major burns (with/without) inhalation injuries and admitted to LASUTH	39
Total	90

Out of the total number of patients seen at LASUTH, 28 (31.11%) were categorized as unsalvageable, while 11 (12.22%) were salvageable. The TBSA of patients classified as salvageable and unsalvageable is shown in Table III.

**Table III** - Emergency Department triage

Patient from b) in Table II categorized as unsalvageable (TBSA $\geq$ 70%)	28
Patients from b) in Table II categorized as salvageable (TBSA $\geq$ 70%)	11
Total	39

No patient in the unsalvageable group survived (mortality rate, 100%). Eight patients in the salvageable group were discharged after full recovery while two sought treatment elsewhere after spending seven days at LASUTH. Only one patient in this group died in hospital (group mortality rate, 9.09%). The total number of deaths among all patients (salvageable and non-salvageable) hospitalized at LASUTH because of the incident was 29, giving a mortality rate of 32.22%.

Table IV presents intra-hospital triage.

**Table IV** - Intra-hospital triage

Patient managed in the High Dependence Burns wards	8
Patients managed in the Critical Care Unit for inhalation injury	3
Total	11

The survivors' age range was 19 to 30 yr (mean, 24.92 yr), while that of the patients who died was 26 to 50 yr (mean, 27.37 yr) (Table V).

**Table V** - Age of patients with burn injury due to petroleum pipeline explosion admitted for treatment at LASUTH

Age of patients managed at LASUTH (no. = 39)	
Range	19-50 yr
Mean	26.74 yr
Age of survivors (no. = 8+2)	
Range	19-30 yr
Mean	24.92 yr
Age of deceased patients (no. = 29)	
Range	29-50 yr
Mean	27.37 yr
Age of patients given first-aid treatment and discharged after 24 hours' observation (no. = 51)	
Range	14-40
Mean	25.62

The pattern of burns sustained by survivors is shown in Table VI. All the patients sustained burns to the head, neck, trunk, or limbs. Only one patient sustained injury to the perineum. Three survivors with inhalation injuries were managed at the Critical Care Unit. These patients survived and were transferred back to the High Dependence Wards after 14 days for wound care. Four surviving patients developed acute psychiatric illnesses and were co-managed with the psychiatrists.

**Table VI** - Patterns and percentages of burn injury sustained by petroleum pipeline explosion survivors

Anatomical part involved	Percentage burns	
	Range	Mean
Head/neck	2-9	4.5
Upper limbs	10-18	14.4
Lower limbs	15-30	22
Trunk	5-30	10
Perineum	1	1

### Surgical procedures

Bronchoscopy was carried out in four patients in order to confirm and ascertain levels of inhalation injuries; ten escharotomies/escharectomies were performed; wound debridement was effected in eight patients and six required skin grafting procedures.

Sixty-two per cent of the patients died within 72 h of admission. Twenty-one per cent died after one week. Nearly 77% of the deceased patients were completely burned.

The causes of death are shown in Table VII.

**Table VII** - Post-mortem findings in patients who died from their burn injuries

Causes of death	Number of patients
Massive burns over 70% TBSA/inhalation injury	23
Multiple organ failure	6
Total	29

The number of victims who were completely burned at the site of the accident was 295, of whom 25.56% had massive burns and 6.66% had multiple organ failure.

### Discussion

Mass burns casualties resulting from fire explosions require extreme efforts and flexibility in their management.<sup>3,14,15</sup> There is a marked deviation from the regular health care system.<sup>5,7,8</sup> Many agents that are used or encountered regularly may be responsible for the disaster.<sup>1,2,5,7</sup> Disasters happen when the safety standards for handling petroleum products are breached.<sup>7</sup> The Abule-Egba disaster on 26 December 2006 occurred when there were leaks in the petroleum pipelines. Petroleum products have various flashpoints. The flashpoint of the PMS that leaked out is 25-30°C, at which temperature the product becomes readily flammable.<sup>15</sup>

Fire from PMS is among the most dangerous causes of burns. Great damage is caused to the environment and the victims suffer extensive visceral and superficial injuries.<sup>1</sup> Often there are associated inhalation injuries due to the toxic fumes of the evaporating PMS, toxic gases from combustion processes, and the resulting hot air containing carbon soot.<sup>1</sup>

PMS fire generally has predictive properties and behaviour. If the source of fuel continues to be available, the flames continue and propagate. The fire starts from a heat source and burns fast, and with a steady supply of fuel it becomes a crown fire. Crown fire consists of flames composed of gases at temperatures varying between 1000 and 2000 °C.<sup>16</sup> The rate of spread may be very fast, causing the explosive-like nature of PMS flames.

The combustion reaction in the fire may sometimes be incomplete, resulting in the production of a great deal of smoke, composed of gases and of condensed and solid products.<sup>16</sup> Carbon particles, by-products of sulphurous compounds, and carbon monoxide, together with other toxic gases, are also present in smoke. The concentration of carbon monoxide in smokes varies, but a concentration of around 10-20 parts per million (ppm) away from the fire line to 100-200 ppm at the edge of the fire is usual.<sup>16</sup>

PMS vaporizes at the usual room temperature in Lagos (30-32 °C) during the period concerned. The resulting vapour catches fire in explosive manner and spreads rapidly.<sup>1,8</sup> Victims in the vicinity of the leaking pipes get total-

ly engulfed - hence the high number of 295 victims totally burned in this study. The resulting burns have same characteristics as burn injury sustained in a closed environment.

Proper management of the victims begins with rescue from the fire. The area should immediately be physically cordoned off, and on-site triage commenced. In the present case, on-site triage was carried out. The total number of the victims taken to LASUTH was 90, while the 295 completely burned and charred victims were taken away for burial.

On-site triage was carried out by the personnel of the State Government Emergency Medical Services. This staff is medically trained but the knowledge of burns management was rudimentary - hence the overcrowding of the Tertiary Burns Centre with all the surviving victims, irrespective of the degrees of their injuries. The average transfer time from the scene of occurrence of the burns to LASUTH and commencement of resuscitation was five hours. This may be considered a significant factor in the increased morbidity and mortality of the victims, as also the delayed onset of appropriate and definitive management. The 90 patients brought for in-hospital triage exceeded the facilities available - the Burns Centre has only 13 beds for admission.

Previous experiences in the management of similar disasters elsewhere have proposed various factors for consideration before transporting the victims to designated facilities. Mackie and Koning<sup>9</sup> advocated expert triage at the scene of the disaster. Welling et al.<sup>14</sup> called for pre-disaster planning, while Anantharaman<sup>8</sup> called for prioritization of the initial management. A total number of 51 patients (56.6%) received first-aid treatment and Emergency Department observation for a short period, and were subsequently either discharged for follow-up or referred to other secondary medical facilities for continuous evaluation and management. This is consistent with similar experiences elsewhere.<sup>5,8,17-20</sup> Ahuja and Battacharya<sup>5</sup> were of the opinion that patients with minor burns in non-critical areas (Group I) and those with minor burns in the hands, face, and genitalia (Group II) could be managed on an out-patient basis in mass disaster situations.

A total number of 39 patients were admitted to LASUTH Burns Centre and the Emergency Department. Out of these, 28 patients were unsalvageable. To classify a patient as unsalvageable, the following criteria will have been considered:

- Staff available and their and experience
- Facilities/resources available
- The Centre's  $L_{50}$  value. The  $L_{50}$  value is the TBSA involvement in burns that are lethal for at least 50% of the patients
- The universally accepted TBSA value with chances of survival in mass burns disaster situations

A burns centre had been established at LASUTH three years before the disaster. There were full compliments of plastic surgeons, residents, and nursing personnel. The centre has 13 adult beds for admission. Supporting facilities are however limited. Although this has not been scientifically verified, the  $L_{50}$  for the centre is about 60% TBSA, which is similar to the  $L_{50}$  in comparable burns centres in Lagos and Ibadan.<sup>2,3</sup>

Various classifications have rated TBSA greater than 60% as low in the priority for both evacuation and sharing of resources during the management of mass burns disaster victims.<sup>3,10</sup> The TBSA of patients categorized as unsalvageable ranged from 61 to 100%. The patients were all admitted into a hospital section created for the occasion. Standard burns management protocols were administered but none survived. Much experience was however gained during their management in the care of severely burned patients. Königová emphasized the importance of psychological components in the triage of burn patients.<sup>21</sup> TBSA, age, aetiological agents, and co-morbidity were not the only significant factors to be considered. The patients' psychological status should also be considered. Equally important is the fact that euthanasia is not normally practised in Nigeria.

Eleven patients were salvageable. These patients were admitted to the burns centre for management. Only one patient died in LASUTH in this group. After spending seven days there, two patients sought management elsewhere. The low mortality (9.09%) in this group may be interpreted as a measure of the effectiveness of the triage system used. However, all care should be taken during triage operations to avoid over-triage, which may lead to the exclusion of patients who might potentially benefit from the

comprehensive management available at a given centre. The high mortality rate (84.16%) among all those involved in the incident (i.e. the 295 persons burned at the site of the pipeline explosion and the 29 who died in hospital out of the 385 victims) shows how dangerous fire explosions from PMS can be. Equally important is the high fatality rate among the patients brought to LASUTH (32.22%). Many of the patients sustained extensive superficial burns. All the patients who underwent diagnostic bronchoscopy for inhalation injury were confirmed positive. Inhalation injury in burns has continued to be an important factor in determining the prognosis in burns - the mortality rate is often high.<sup>3</sup> Three patients in the salvageable group presented clinical evidence of inhalation injury. The inhalation injuries were successfully managed in the hospital's Critical Care Unit.

### **Conclusions and recommendations**

Mass burn injuries resulting from petroleum products pipeline explosions are very difficult to manage in a developing country. They are associated with high mortality and case fatality rates. The best treatment for burns is to prevent their occurrence. All safety regulations regarding the handling of petroleum products must be strictly adhered to. People must be trained to treat and handle petroleum products with caution. However, before disasters strike, adequate facilities and personnel for management must be provided.

A good system of triage conducted by specialists at various levels can result in the effective management of salvageable patients.

**RÉSUMÉ.** Les Auteurs se proposent de considérer les principes de base du triage dans les désastres en masse par feu et de discuter l'expérience de l'Hôpital Universitaire d'État de Lagos (LASUTH), Ikeja, Nigeria, dans le désastre de décembre 2006 à Abule-Egba, Lagos, Nigeria. Ils espèrent que l'expérience qu'ils ont gagnée puisse être utile dans la préparation et la gestion des désastres de la même gravité dans les pays en voie de développement qui ne disposent pas de services adéquats. Les lésions provoquées par les brûlures ont été décrites comme la forme de traumatisme la plus sévère, dont la gestion est très difficile. Pour cette raison il faut garantir une gestion experte du désastre, confiée à un personnel bien qualifié dans des centres bien équipés et dédiés. Dans les désastres de masse le numéro total des victimes peut excéder la capacité du service et du personnel et dans ce cas il faut élaborer un système qui met de l'ordre dans les patients et permet de soigner ceux qui peuvent bénéficier des traitements disponibles. Les autres patients sont envoyés à d'autres services médicaux pour continuer le traitement ou renvoyés à la maison, après avoir reçu la thérapie de base, pour les soins post-hospitaliers. Dans les pays en voie de développement, les expériences documentées de la gestion des désastres en masse par brûlure provoqués par l'explosion d'un gazoduc de pétrole sont rares. Au contraire, les explosions des pipelines de pétrole, spécialement dans la zone de Lagos, sont relativement communes. Ces cas ont été associés avec une variété de facteurs, et la morbidité et la mortalité ont été élevées. LASUTH possède un centre dédié des brûlés qui reçoit et traite un grand nombre de ces patients. Le triage est la procédure médicale de dépistage qui vérifie les conditions des patients et leurs nécessités thérapeutiques, toujours en tenant compte des ressources disponibles. Les Auteurs discutent les buts du triage, comme aussi ses divers niveaux et les objectifs finaux. Tous les patients atteints de brûlures dans le désastre de l'an 2006 ont été étudiés, et le triage effectué aux divers niveaux différents est décrit, avec les modalités de la sélection des patients. Tous les patients ont reçu le traitement standard pour les brûlures. En tout, 385 personnes ont subi des brûlures de degré variable causées par l'explosion du pipeline. Sur le site de l'accident un triage du service d'urgence et un triage intrahospitalier ont été effectués. Quarante-vingt-dix patients ont été transférés au service d'urgence de LASUTH, dont 51 (56,67%) ont reçu un traitement

immédiat au poste de secours et ensuite ou renvoyés pour être traités en régime extrahospitalier ou transférés au service des soins sanitaires secondaires. Des 39 patients qui restaient, atteints de brûlures dans plus de 70% de la surface corporelle totale, 28 (31,11%) ont été catégorisés comme «insauvables» et 11 (12,22%), atteints de brûlures en moins de 70% de la surface corporelle totale, comme «sauvables». Tous les patients du groupe «insauvable» et un patient du groupe «sauvable» sont morts (mortalité respectivement 100% et 9,09%). Le taux de mortalité à cause de la rupture du pipeline était 84,16%; le taux de mortalité pour tous les patients visités à LASUTH était 32,22%. Les Auteurs discutent la nécessité de la prudence dans le maniement des produits de pétrole et soulignent l'efficacité du système de triage utilisé. En conclusion, les brûlures causées par les produits inflammables du pétrole peuvent être très dangereuses. Pour toutes ces raisons il faut effectuer un triage approprié et les patients «sauvables» doivent être suivis par des experts dans des centres de brûlures dédiés.

## BIBLIOGRAPHY

1. Yiltok S.T., Isamade E.S., Dba A.F.: Outcome of burn patients managed in a general intensive care unit. *Nig. J. Surg.*, 11: 1-4, 2005.
2. Sowemimo G.O.A.: Burn injuries in Lagos. *Burns*, 9: 280-3, 1983.
3. Adigun I.A., Oluwatosin O.M., Adeyemo A.A., Olumese P.E.: A study of survival after major burns at Ibadan. *Niger. Med. J.*, 45: 71-4, 2004.
4. "Advanced Trauma Life Support Instructor Manual". American College of Surgeons (6th ed.), Chicago IL, 1977.
5. Ahuja R.B., Battacharya S.: Burns in the developing world and burns disasters. *BMJ*, 329: 447-49, 2004.
6. Irebulum L.M., Nnabuko P.E.: Epidemiology of childhood thermal injuries in Enugu, Nigeria. *Burns*, 19: 223-6, 1993.
7. Mor M., Waisman Y.: Triage principles in multiple casualty situations involving children. The Israeli experience. *Pediatric Emergency Medicine Database (serial online)*, 2002.
8. Anatharaman V.: Burns mass disasters; aetiology, predisposing situations and initial management. *Ann. Acad. Singapore*, 21: 635-9, 1992.
9. Mackie D.P., Koning H.M.: Fate of mass burn casualties. Implications for disaster planning. *Burns*, 3: 203-6, 1990.
10. Reda Mabrouk A.W.: The management of burn injuries in mass casualties. *Ann. Medit. Burns Club*, 3: 112-3, 1990.
11. American College of Surgeons Committee on Trauma. Field categorization of trauma victims. *Bull. Am. Coll. Surg.*, 71: 17-21, 1986.
12. Super G., Groth S., Hook R. et al.: START. Simple Triage And Rapid Treatment. Plan. Newport Beach, CA. Hoag Memorial Presbyterian Hospital, 1994.
13. Wesson D.E., Scorpio R.: Field triage - help or hindrance? *Can. J. Surg.*, 35: 19-21, 1992.
14. Welling L., Van Harten S.M., Patka P. et al.: Medical management after indoor fires, a review. *Burns*, 6: 673-8, 2005.
15. Oduwole E.O., Sanni A.O., Odusanya O., Fadeyibi I.O.: Contaminated kerosene burns disaster in Lagos, Nigeria. *Ann. Medit. Burns Club*, 16: 208-16, 2003.
16. Viegas D.X.: Fire behaviour and fire-line safety. *Ann. Medit. Burns Club*, 6: 179-85, 1993. 1998
17. Urhobo Historical Society: Causes of the Idjerhe Fire Disaster. [disera@infoweb.abs.net](mailto:disera@infoweb.abs.net), 1998.
18. Leslie C.L., Cushman C., McDonald G.S., Joshi W. et al.: Management of multiple burn casualties in a high volume ED without a verified burn unit. *American J. Emergency Medicine*, 19: 469-73, 2001.
19. Kennedy P.J., Haertsch P.A., Maifz P.K.: The Bali disaster, implications and lessons learned. *J. Burn Care Rehabil.*, 26: 125-31, 2005.
20. United States Department of Health and Human Services. Burn triage and treatment: Thermal injuries (s.d.).
21. Königová R.: Ethical problems in mass disasters. *Ann. Medit. Burns Club*, 6: 190-2, 1993.

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