African Journal of Emergency Medicine 7 (2017) 130–134

Contents lists available at ScienceDirect

African Journal of Emergency Medicine

journal homepage: www.sciencedirect.com

Original Article

Epidemiology, clinical characteristics and outcomes of head injured patients in an Ethiopian emergency centre

Megan Landes [a,b,c,*], Raghu Venugopal [a,c,d], Sara Berman [a,c], Spencer Heffernan [e], James Maskalyk [a,d,f], Aklilu Azazh [g]

[a] Global Health Emergency Medicine, University of Toronto, ON, Canada
[b] Department of Family and Community Medicine, University of Toronto, Toronto, ON, Canada
[c] University Health Network, Toronto, ON, Canada
[d] Department of Medicine, University of Toronto, Toronto, ON, Canada
[e] Department of Anesthesia, University of Toronto, Toronto, ON, Canada
[f] St. Michael's Hospital, Toronto, ON, Canada
[g] Addis Ababa University, School of Medicine, Department of Emergency Medicine, Addis Ababa, Ethiopia

ARTICLE INFO

Article history:
Received 11 July 2016
Revised 20 January 2017
Accepted 12 April 2017
Available online 24 May 2017

Keywords:
Head injury
Emergency medicine
Low resource setting
Epidemiology
Outcomes

ABSTRACT

Introduction: Head injury is a leading cause of mortality in Africa. We characterise the epidemiology and outcomes of head injury at an Ethiopian emergency centre.
Methods: We conducted a prospective cohort study of all head injured patients presenting to the Emergency Centre of Tikur Anbessa Specialised Hospital, Addis Ababa. Data was collected via a standardised form from the patient's chart, radiology reports and operative reports. Patients were followed until discharge, facility transfer, death, or 7 days in hospital. Consent was obtained from the patient or substitute decision maker.
Results: Among 204 head injured patients enrolled, the majority were <30 years old (51.0%) and male (86.8%). Forty-one percent of injuries occurred from road traffic accidents (RTAs). A significant number of patients had at least one indicator of severe injury on presentation: 51 (25.0%) had a GCS < 9, 53 (26.0%) had multi-system trauma, 95 (46.6%) had ≥1 abnormal vital sign and of the 133 patients with data available, 37 (27.8%) had a Revised Trauma Score (RTS) < 6. Patients injured by RTA were more likely to have indicators of severe injury than other mechanisms, including multi-system trauma (OR 3.2, 95% CI 1.7–6.2, p = 0.00), GCS < 9 (OR 3.7, 95% CI 1.8–7.4, p = 0.00), ≥1 abnormal vital sign (OR 2.5, 95% CI 1.4–4.6, p = 0.00) or an RTS score < 6 (OR 3.6, 95% CI 1.6–8.1, p = 0.00). Overall, 149 (73.0%) patients were discharged from hospital, 34 (16.7%) were transferred to another hospital, and 21 patients died (10.3%). In multivariable analysis, death was significantly associated with age over 60 years (aOR 68.8, 95% CI 2.0–2329.0, p = 0.02), GCS < 9 (aOR 14.8, 95% CI 2.2–99.5, p = 0.01), fixed bilateral pupils (aOR 39.1, 95% CI 4.2–362.8, p < 0.01) and hypoxia (oxygen saturation <90%; aOR 14.2%, 95% CI 2.6–123.9, p = 0.01).
Conclusion: Head injury represents a significant risk for morbidity and mortality in Ethiopia, of which RTA's increase injury severity. Targeted approaches to improving care of the injured may improve outcomes.

African relevance

- Head injury is a significant cause of morbidity and mortality in Africa.
- This patient population presents challenges for developing emergency systems.
- This study was initiated to better understand the burden of head injuries in Addis Ababa and to inform trauma services development.

Peer review under responsibility of African Federation for Emergency Medicine.
* Corresponding author.
E-mail address: mclandes@gmail.com (M. Landes).
URL: https://twitter.com/MeganLandes (M. Landes).

http://dx.doi.org/10.1016/j.afjem.2017.04.001

Introduction

Globally, injuries kill more people each year than HIV, TB, and malaria combined. The World Health Organization (WHO) estimates 5.8 million annual injury-related deaths and that 90% of them occur in low- and middle-income countries (LMICs) [1].

Head injury specifically is a leading cause of death and disability among the injured in LMICs [2,3]. In Africa, one-third of all head injured patients suffer poor outcomes, and those patients with severe head injury have almost twice the risk of dying compared to those in high-income countries [4,5]. Strained health systems in the region contribute to these outcomes and improving access to pre-hospital, emergency and specialist surgical interventions may improve these outcomes [5–9].

In Ethiopia, Addis Ababa University's Tikur Anbessa Specialized Hospital (TASH) is the country's largest public hospital and only neurosurgical and trauma referral centre. At TASH, head injury is a leading cause of mortality. A retrospective review found head injury accounted for almost 60% of deaths among trauma patients admitted to the surgical service from 2002 to 2006 [10]. Additionally, a more recent review of mortality in the emergency centre showed that 21.5% of all deaths occurring less than 72 h after presentation were as a result of head injury [11].

Since 2010, Ethiopia has been committed to improving trauma care systems via increasing pre-hospital care systems and training the first cadres of emergency medicine physicians and nurses at Addis Ababa University (AAU). Given the intention of Ethiopia to improve the care of the injured, we conducted a prospective cohort study of all head injured patients in the emergency centre at TASH to provide an accurate understanding of the epidemiology, characteristics and outcomes of head injury and provide evidence for practitioners and policy makers to improve outcomes.

Methods

We conducted a prospective cohort study of all head injured patients presenting to the Tikur Anbessa Specialized Hospital Emergency Centre (TASH-EC) in Addis Ababa, Ethiopia from May to October 2012. The TASH-EC is an adult emergency centre, with over 180,000 patient visits a year (over the age of 13 years). TASH is the county's main trauma referral centre in the public system and daily estimates of trauma patients are over 15 per day. TASH has Computed Tomography (CT) capability along with a limited number of intensive care unit beds, and general, orthopaedic and neurosurgical services. If a service is not available to a patient due to resource constraints, efforts are made in the emergency centre to transfer a patient to another facility in Addis Ababa which could provide those services.

All patients triaged as "isolated head injury" or "multi-system trauma with head injury" were included in the study. Patients were identified via the triage registry by trained study personnel who were in the emergency centre for approximately 18 h a day. Attempts were made on a daily basis to communicate with clinical staff to identify patients whose triage diagnosis did not initially identify their head injury for inclusion in the study. Written informed consent was obtained from capable patients or via a substitute decision maker by a study team member. Written informed consent was obtained from next of kin for all minors. Ethics approval was granted by the Institutional Review Board of Addis Ababa University and the Research Ethics Board of the University Health Network, Toronto, Canada. Consent was documented on a consent form as per the approved procedures of both institutional ethics committees.

Trained study personnel prospectively and retrospectively collected data using a standardised data collection form. Data was extracted from the hospital chart including socio-demographics information, mechanism of injury, clinical characteristics on presentation and clinical management in the emergency centre. Clinical data, along with the Glasgow Coma Score (GCS) and vital signs were either extracted from the charts (if recently completed) or assessed by trained research personnel at the following time points from admission: 0, 6, 12, 24, 72 h and 7 days. Patients were followed until the end point of death, discharge from hospital, or transfer to another facility.

All data was entered into an Excel spreadsheet and analysed using STATA 11.0 (StataCorp, Texas, USA). Baseline characteristics were summarised using means and standard deviations for continuous variables, and counts and percentages for categorical variables. The Revised Trauma Score (RTS) was calculated using the standard definition [12]. Severity of head injury was defined as mild (GCS 13–15), moderate (GCS 9–12) or severe (GCS < 9). Tests for association were conducted using Pearson's chi-squared test. Multivariable logistic regression analysis was used to produce estimates of the adjusted impact of each variable on mortality.

Results

Overall, 204 patients with head injury were included in the cohort, of which, the majority were less than 30 years old (n = 104, 51.0%) and male (n = 177, 86.8%).

Among the 201 patients with a recorded mechanism of injury, road traffic accidents (RTAs) caused over 40% of all head injuries in the cohort (n = 82, 41.0%), with pedestrians struck by a vehicle being the most common type of RTA (n = 50, 61.0%). Twenty (10.0%) patients sustained head injuries at their workplace, either as a result of a fall (n = 9, 45%) or as a driver in an RTA (n = 4, 20%).

A significant number of patients had at least one indicator of severe injury on presentation (Table 1): 51 (25.0%) had a GCS < 9, 53 (26.0%) had multi-system trauma, 95 (46.6%) had at least one abnormal vital sign and of the 133 patients with complete data available, 37 (27.8%) had a Revised Trauma Score (RTS) < 6.

Table 2 describes injury severity by their mechanism of injury. Patients injured by an RTA were more likely to have indicators of severe injury than patients with other mechanisms, including multi-system trauma (odds ratio (OR) 3.2, 95% CI 1.7–6.2, p = 0.00), GCS < 9 (OR 3.7, 95% CI 1.8–7.4, p = 0.00), at least one abnormal vital sign (OR 2.5, 95% CI 1.4–4.6, p = 0.00) or an RTS score < 6 (OR 3.6, 95% CI 1.6–8.1, p = 0.00). Patients injured either by fall or assault had significantly higher rates of acute pathology evident on CT scan when compared to those injured in an RTA: 36.1% of falls had a subdural hematoma (p = 0.01) and 30.1% of assaulted patients had an epidural hematoma (p = 0.01).

Table 3 describes patient outcomes stratified by the severity of head injury (i.e. GCS) on presentation to the emergency centre. Twenty-nine patients had a neurosurgical intervention, the majority of whom had mild head injuries (GCS 13–15 on arrival) and 28 of them were discharged home (96.5%).

Overall, 149 (73.0%) patients were discharged from the hospital: 21.5% of patients were discharged with either persistent moderate or severe head injury (i.e. 20 with GCS 9–12 and twelve with GCS < 9). Additionally, 13 (8.7%) patients were discharged home with a persistent focal neurologic finding (twelve with hemiparesis and one with aphasia; not in table).

Among the 22 patients who presented with severe head injury but were ultimately discharged home, seven (31.8%) were discharged in the same condition (GCS < 9), 14 (63.6%) left hospital with some improvement (six with GCS 9–12 and eight with GCS > 13). Two patients were discharged with persistent focal neurologic findings.

Table 1
Socio-demographic and clinical characteristics of patients presenting with head injury (n = 204).

Variable	Total n (%)
Age (years)	
<16	9 (4.4)
16–29	104 (51.9)
31–45	49 (24.0)
46–60	26 (12.8)
> 60	7 (3.4)
Unknown	9 (4.4)
Male	177 (86.8)
Female	27 (13.2)
Alcohol-related	24 (11.8)
Workplace Injury	20 (9.8)
Arrival to EC	
Ambulatory	7 (3.4)
By private car	21 (10.3)
By taxi	140 (68.6)
By ambulance	30 (15.2)
By police	2 (1.0)
Unknown	3 (1.5)
Multi-system trauma	53 (26.0)
Glasgow Coma Scale at Arrival	
12–15	108 (53.0)
9–11	39 (19.1)
8 or less	51 (25.0)
Not recorded	6 (3.0)
Abnormal Vital Signs	
SBP < 90	12 (5.9)
RR > 20	55 (27.0)
Hypoxia	42 (20.6)
HR > 100	34 (16.7)
Pupillary Reaction	
Bilateral non-reactive	19 (9.3)
Unilateral non-reactive	12 (5.9)
Bilateral reactive	169 (82.8)
Focal Neurologic Deficit	25 (12.3)
Revised Trauma Score**	
1	1 (0.8)
2	1 (0.8)
3	2 (1.5)
4	11 (8.3)
5	22 (16.5)
6	31 (23.3)
7	65 (48.9)
CT Scan Diagnosis	
Skull Fracture	70 (34.3)
Basilar Fracture	14 (5.9)
Epidural Hematoma	37 (18.1)
Subdural Hematoma	36 (17.7)
Subarachnoid Hemorrhage	13 (6.4)

EC, Emergency centre; SBP, systolic blood pressure; RR, respiratory rate; HR, heart rate; CT, Computed Tomography; **, n = 133 patients with complete data for calculation of Revised Trauma Score.

Overall, 21 patients in the cohort died (10.3%); twelve (57.1%) of whom died within 48 h of presentation to the emergency centre. Data on the final outcome of 34 transferred patients was unavailable, however documented reasons for transfer suggest a significant proportion of these patients had indicators of severe injury: 21 (61.8%) had an initial GCS < 13, nine (26.5%) had an RTS score < 6 and 21 (61.8%) were documented as needing transfer for intensive care or neurosurgical services at another site.

The highest mortality among all mechanisms of injury was seen in those patients sustaining a head injury as a pedestrian struck in an RTA (18.0% died, as compared to 7.7% of all other mechanisms combined, p = 0.03; Table 2). Furthermore, head injured patients from any type of RTA mechanism (including driver, passenger or pedestrian) had a threefold increased risk of death compared to all other mechanisms when controlled for age (adjusted odds ratio (aOR) 2.8, 95% CI 1.0–7.4, p = 0.04).

Complete data was available for 113 patients for both RTS and final outcome (i.e. those patients not transferred to another facility documented as either died or discharged). Among this subset, mortality rates were highest in those with RTS < 4 (66.7%) and RTS = 4 (57.1%) and lower among those with RTS 5 (27.8%), RTS 6 (7.7%) and RTS 7 (0%).

Table 4 presents the clinical characteristics of patients on presentation to the emergency centre that were significantly associated with death, including age over 60 years (aOR 68.8, 95% CI 2.0–2329.0, p = 0.02), GCS < 9 (aOR 14.8, 95% CI 2.2–99.5, p = 0.01), fixed bilateral pupils (aOR 39.1, 95% CI 4.2–362.8, p < 0.01) and hypoxia (oxygen saturation < 90%; aOR 14.2%, 95% CI 2.6–123.9, p = 0.01).

Discussion

We report a high severity of injury among a cohort of head injured patients in an urban emergency centre in Ethiopia. Similar cohorts of injured patients in sub-Saharan Africa have shown comparable rates of head injury severity [13–15] as well as that the majority of head injuries occur among males and young persons [4,16,17]. This degree of severity among a predominantly young population is cause for concern regarding both the individual, in terms of quality of life, and for society, in terms of lost productivity.

The impact of road traffic accidents (RTAs) on injury in this cohort is also significant, as RTAs were the most common mechanism of injury, and patients injured by RTA had an increased risk of injury severity and death. The World Health Organization (WHO) estimates that the African region has the highest RTA-related mortality rate in the world (24.1 per 100,000 population vs. 10.3 per 100,000 in Europe), and that 38% of these deaths occurring among "vulnerable road users" (i.e. pedestrians and cyclists) [18] Additionally, estimates in Ethiopia of the number of persons killed or seriously injured following RTAs are 30 times higher than that of the United States of America [19]. The impact of RTAs on Africa has been noted to be related to a lack of road safety standards and regulation of elements such as speed reduction and the use of protective equipment such as helmets, which can lead to increased severity [18]. Attention to road safety would greatly impact the burden of injury in this population, and the road has now been included in the WHO's Sustainable Development Goals, specifically to halve the number of deaths from RTAs by 2020 [20].

In this cohort, we report significant poor outcomes (i.e. either death or disability on discharge) among head injured patients. In a study comparing geographic variations in outcome of patients with severe head injury, patients in low-income countries had much higher rates of mortality when compared to high-income countries [21]. These authors cited limited access to early pre-hospital services, treatment to prevent secondary injury (such as from hypoxia or hypotension), or availability of neurosurgical services as contributing factors in these settings [21]. Indeed, in our setting, we can see the potential impact of these three identified areas on patient outcomes. First, the majority of patients arrived by private car or taxi, without pre-hospital services. Secondly, while the first cadres of emergency specialist physicians and nurses have recently graduated and are working in this setting, their ability to prevent secondary injury is often hampered by limited infrastructure (i.e. lack of ventilators or limited blood products) [22]. Finally, surgical capacity remains limited as a review of emergency neurosurgical cases at TASH in 2010 showed a median time of three days to neurosurgical consultation for emergency

Table 2
Injury severity characteristics by mechanism of injury.^

	Road traffic accident: Driver or Passenger n = 32	Road traffic accident: Pedestrian n = 50	Fall n = 36	Assault n = 83	p-Value
Multi-system trauma	12 (37.5)	20 (40.0)	5 (13.9)	16 (19.3)	0.02
Glasgow Coma Scale at Arrival					
12–15	15 (46.9)	17 (34.0)	15(41.7)	60 (72.3)	<0.01
9–11	6 (18.8)	12 (24.0)	7 (19.4)	14 (16.9)	
8 or less	10 (31.3)	21 (42.0)	11 (30.6)	7 (8.4)	
Not recorded	1 (3.1)	0 (0)	3 (8.3)	2 (2.4)	
Abnormal Vital Signs					
SBP < 90	2 (6.3)	4 (8.0)	0 (0)	5 (6.0)	0.75
RR > 20	10 (31.3)	18 (36.0)	11 (30.1)	14 (16.9)	0.05
Hypoxia	13 (40.6)	13 (26.0)	10 (27.8)	6 (7.2)	<0.01
HR > 100	7 (21.9)	9 (18.0)	7 (19.4)	10 (12.1)	0.95
Revised Trauma Score**					
<4	0 (0)	2 (5.3)	1 (4.8)	1 (1.9)	<0.01
4	5 (27.8)	4 (10.5)	0 (0)	1 (1.9)	
5	2 (11.1)	10 (26.3)	6 (28.6)	3 (5.7)	
6 or 7	11 (61.1)	22 (57.9)	14 (66.7)	48 (90.6)	
CT Scan Diagnosis					
Skull Fracture	5 (15.6)	11 (22.0)	11 (30.6)	42 (50.6)	<0.01
Basilar Fracture	2 (6.3)	3 (6.0)	3 (8.3)	5 (6.0)	0.56
Epidural Hematoma	3 (9.4)	4 (8.0)	5 (13.9)	25 (30.1)	0.01
Subdural Hematoma	4 (12.5)	10 (20.0)	13 (36.1)	9 (10.8)	0.01
Subarachnoid Hemorrhage	3 (9.4)	4 (8.0)	3 (8.3)	3 (3.6)	0.36
Outcome					
Discharged	19 (59.4)	32 (64.0)	29 (80.6)	67 (80.7)	0.03
Death	3 (9.4)	9 (18.0)	4 (11.1)	4 (4.8)	
Transferred	10 (31.3)	9 (18.0)	3 (8.3)	12 (14.5)	

SBP, systolic blood pressure; RR, respiratory rate; HR, heart rate; CT, Computed Tomography; ^. For 201 patients with known mechanism of injury; **, n = 130 patients with complete data for calculation of Revised Trauma Score.

Table 3
Clinical outcome by head injury severity on presentation to the Emergency Centre.

	Glasgow Coma Scale on Arrival (GCS)**				
	Mild (GCS 13–15) n = 108	Moderate (GCS 9–12) n = 39	Severe (GCS < 8) n = 51	Unknown n = 6	P-value
Neurosurgical Intervention	18 (16.7)	7 (18.0)	4 (7.8)	0	0.56
Outcome					
Death	0	3 (7.7)	16 (31.4)	2 (33.3)	0.00
Transferred	16 (14.8)	5 (12.8)	13 (25.5)	0	
Discharged	92 (85.2)	31 (79.5)	22 (43.2)	4 (66.7)	
GCS at discharge*	74 (80.4)	15 (48.4)	8 (36.4)	2 (50.0)	0.00
Mild	1 (1.1)	12 (38.7)	6 (27.3)	1 (25.0)	
Moderate	4 (4.4)	1 (3.2)	7 (31.8)	0	
Severe Unknown	13 (14.1)	3 (9.7)	1 (4.6)	1 (25.0)	

GCS, Glasgow Coma Scale; *, n = 149 patients discharged from TASH.

cases, and a further time to the operating room of one day [23]. Authors note contributing factors such as a lack of resources such as diagnostic and therapeutic facilities, and appropriately staffed beds for admission that may impact patient outcomes [23].

We have identified risk factors for mortality in this cohort, including older age, severe head injury, fixed pupils and hypoxia on presentation. These risk factors for mortality are consistent with other studies [16,17,24–27] and deserve special attention in identifying patients at risk of mortality in the emergency centre. Protocols to mitigate the impact of secondary injury and expedite definitive care may improve outcomes in this setting.

Several limitations are identified in this study. First, as TASH-EC is Ethiopia's main trauma referral centre, which accepts patients from peripheral clinics and hospitals, the study population may not be representative of other sites in Ethiopia and we may be overestimating the burden of injury. Secondly, we are unable to report on outcomes of patients transferred to other sites, but given that the data we do have on these patients suggests a high degree of injury severity, our data may underestimate death and disability. Finally, we report on risk factors for mortality that may be limited by a small sample size.

In conclusion, this study reports a significant degree of morbidity and mortality associated with head injury presenting to the emergency centre of this urban academic teaching hospital and trauma referral centre in Addis Ababa, Ethiopia. Given these findings of the study, a targeted approach to improving outcomes of head injured patients must include multiple levels of engagement. First, attention to prevention must be addressed at a public health and policy level to improve road traffic safety and work safety. Second, strengthening pre-hospital services and trauma care throughout the system will greatly impact patient outcomes of injured patients. Finally, a coordinated effort may allow this injured group of economically productive citizens their best chance of recovery.

Table 4
Multivariable analysis of socio-demographic and clinical risk factors for mortality.*

	Alive (N = 149)	Died (N = 21)	p-Value	Adjusted OR (95% CI) p-value
Age (years)				
<16	8 (5.4)	0 (0)	0.03	
16–30	81 (54.4)	5 (23.8)		1.0
31–45	32 (21.5)	8 (38.1)		3.6 (0.5–28.0) 0.23
46–60	18 (12.1)	4 (19.1)		1.2 (0.1–13.1) 0.90
>60	5 (3.4)	1 (4.8)		71.9 (2.1–2421.0) 0.02
Not recorded	5 (3.4)	3 (14.3)		20.1 (0.5–784.8) 0.11
GCS on arrival				
9–15	123 (82.6)	3 (14.3)	0.00	1.0
<9	22 (14.8)	16 (76.2)		14.6 (2.2–98.9) < 0.01
Not recorded	4 (2.7)	2 (9.5)		
Pupillary Reaction				
Bilateral non-reactive	6 (4.0)	11 (52.4)	0.00	31.6 (3.4–293.5) < 0.01
Unilateral non-reactive	7 (4.7)	3 (14.3)		4.0 (0.3–56.8) 0.30
Bilateral reactive	134 (89.9)	5 (23.8)		1.0
Hypoxia on Arrival (O2 saturation < 90%)	20 (13.4)	13 (61.9)	0.000	12.0 (1.3–107.7) 0.03

GCS, Glasgow Coma Scale; *, n = 170 (excludes patients transferred with unknown outcomes).

Dissemination of results

The results of this study have been presented to the Emergency Department of Tikur Anbessa Specialized Hospital in Addis Ababa University and at the African Federation of Emergency Medicine Conference in Addis Ababa, Ethiopia in 2014.

Author's contributions

ML, RV, JM, AA designed the study. ML, RV, AA collected data. ML, RV, JM, AA carried out data analysis/interpretation. ML, RV, SB, SH, JM drafted the manuscript. ML, RV, SB, SH, JM, AA revised and approved the final version that was submitted.

Conflict of interest

This project was supported by a grant from the University Health Network Emergency Department Research Committee. The authors declare no other conflicts of interest.

Acknowledgements

The authors would like to thank University Health Network Emergency Department Research Committee who provided generous support for this project.

References

[1] Mock C, editor. Strengthening care for the injured: success stories and lessons learned from around the world. World Health Organization; 2010.
[2] Murray CJL, Lopez AD. The global burden of disease: a comprehensive assessment of mortality and disability from diseases, injuries, and risk factors in 1990 and projected to 2020. Harvard University Press; 1996.
[3] Hyder AA, Wunderlich CA, Puvanachandra P, et al. The impact of traumatic brain injuries: a global perspective. NeuroRehabilitation 2007;22:341e53.
[4] Emejulu JKC, Isiguzo CM, Agbasoga CE, et al. Traumatic brain injury in the Accident and Emergency Department of a Tertiary Hospital in Nigeria. East Cent Afr J Surg 2010;15:28–38.
[5] De Silva MJ, Roberts I, Perel P, et al. Patient outcome after traumatic brain injury in high-, middle- and low-income countries: analysis of data on 8927 patients in 46 countries. Int J Epidemiol 2009;38:452–8.
[6] El-Gindi S, Mahdy M, Azeem AA. Traumatic brain injuries in developing countries. Road war in Africa. Rev Esp Neuropsicol 2001;3:3–11.
[7] Razzak JA, Kellermann AL. Emergency medical care in developing countries: is it worthwhile? Bull World Health Organ 2002;80:900–5.
[8] Chowdhury T, Kowalski S, Arabi Y, Dash HH. Pre-hospital and initial management of head injury patients: an update. Saudi J Anaesth 2014;8:114–20. , http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3950434/.
[9] Chesnut RM, Ghajar J, Maas AIR, et al. Early indicators of prognosis in severe traumatic brain injury. Brain Trauma Foundation; 2000. https://www.braintrauma.org/pdf/protected/prognosis_guidelines.pdf.
[10] Biluts H, Bekele A, Kottiso B, et al. In-patient surgical mortality in Tikur Anbessa Hospital: a five-year review. Ethiop Med J 2009;47:135–42.
[11] Hunchak C, Teklu S, Meshkat N, et al. Patterns and predictors of early mortality among emergency department patients in Addis Ababa. Ethiop BMC Res Notes 2015;8:605. , http://www.biomedcentral.com/1756-0500/8/605.
[12] Champion HR, Sacco WJ, Copes WS, et al. A revision of the trauma score. J Trauma 1981;29:623–9.
[13] Chalya PL, Kanumba ES, Mabula JB, et al. Aetiological spectrum, injury characteristics and treatment outcome of head injury patients at Bugando Medical Centre in north-western Tanzania. Tanzania J Health Res 2011;13:74–81.
[14] Emejulu JK. Epidemiological patterns of head injury in a newly established neurosurgical service: one-year prospective study. Afr J Med Med Sci 2008;37:383–8.
[15] Adeleye AO, Olowookere KG, Olayemi OO. Clinicoepidemiological profiles and outcomes during first hospital admission of head injury patients in Ikeja, Nigeria. A prospective cohort study. Neuroepidemiology 2009;32:136–41.
[16] Saidi H, Mutiso BK, Ogengo J. Mortality after road traffic crashes in a system with limited trauma data capability. J Trauma Manag Outcomes 2014;8:4.
[17] Quereshi JS, Ohm R, Rajala H, et al. Head injury triage in a sub Saharah African urban population. Int J Surg 2013;11:265–9.
[18] World Health Organization. Global Status Report on Road Safety 2013: Supporting a Decade of Action; 2013. http://www.who.int/violence_injury_prevention/road_safety_status/2013/en/.
[19] Persson A. Road traffic accidents in Ethiopia: magnitude, causes and possible interventions. Adv Transp Stud Int J 2008;15:5–16.
[20] United Nations. Report of the Secretary-General: Progress towards the Sustainable Development Goals. (June 2016): E/2016/75/.
[21] Georgoff P, Sudha M, Mirza K, et al. Geographic variation in outcomes from severe traumatic brain injury. World Neurosurg 2010;74:331–45.
[22] Azazh A, Teklu S, Woldetsadi A, et al. Emergency medicine and its development in Ethiopia with emphasis on the role of Addis Ababa University, School of Medicine, Emergency Medicine Department. Ethiop Med J 2014(Suppl 2):1–12.
[23] Cadotte DW, Viswanathan A, Cadotte A, et al. The consequence of delayed neurosurgical care at Tikur Anbessa Hospital, Addis Ababa, Ethiopia. World Neurosurg 2010;73:270–5.
[24] Hukkelhoven CW, Steyerberg EW, Rampen AJ, et al. Patient age and outcome following severe traumatic brain injury: an analysis of 5600 patients. J Neurosurg 2003;99:666–73.
[25] McIntyre A, Mehta S, Aubut J, et al. Mortality among older adults after a traumatic brain injury: a meta-analysis. Brain Inj 2013;27:31–40.
[26] Mwang'ombe NJ, Kiboi J. Factors influencing the outcome of severe head injury at Kenyatta National Hospital. East Afr Med J 2001;78:238–41.
[27] Minardi J, Crocco TJ. Management of traumatic brain injury: first link in chain of survival. Mt Sinai J Med 2009;76:138–44.