ISSN 2073-9990 East Cent. Afr. J. surg

Traumatic brain injury patients: direct versus inter-facility transfer time to neurosurgical center and the effects on outcome

Mathias .O.N. Nnadi[1], Olufemi B. Bankole[2]
[1] Division of Neurosurgery, Department of Surgery, University of Calabar Teaching Hospital, Calabar, Nigeria.
[2] Neurosurgical Unit, Department of Surgery, Lagos University Teaching Hospital, Idi-Araba, Lagos, Nigeria.
Correspondence to: Dr Nnadi Mathias O N**,** E-mail: nnadimon@yahoo.com

Background: ***Traumatic brain injury (TBI) is one of the leading causes of death world-wide. Trauma system helps quick transfer of patients to trauma centers. Lack of organized trauma system leads to delay in transferring neurosurgical patients to neurosurgical centers. The main objective of this study was to determine the time lag in TBI patients transferred from trauma scene and those referred from other health facilities to neurosurgical center and the effects on outcome and hospital stay.***
Methods*: It was a prospective study of TBI patients managed by our neurosurgical center from November 2010 to October 2013. Patients' data were collected in accident and emergency, wards and out-patient clinic using structured proforma that was component of our prospective data bank that was approved by Ethics Committee. The data was analyzed using Epi Info 7 Software.*
Results: ***Two hundred and twenty one patients were studied. There were 166 males. One hundred and one patients came direct from trauma scene. The median time to neurosurgical review was 5 hours for direct and 28 hours for referred patients. Mode of presentation did not affect the outcome and hospital stay significantly.***
Conclusion: ***Mode of presentation did not affect the outcome and hospital stay significantly.***

Key words: traumatic brain injury, direct transfer, referred, outcome, hospital stay

Introduction

Traumatic brain injury is often referred to as 'the silent epidemic', causing great personal suffering to victims and relatives and economic burden to the society.[1,2] Brain Trauma Foundation pre-hospital guidelines recommends direct transport of patients with TBI to hospitals with availability of neurosurgical care including CT scanning, intracranial monitoring and treatment.[3] Direct transport of patients from trauma scene to specialized trauma centers has been shown to significantly increase survival.[4] We studied time lag for patients transported direct from trauma scene and those referred from other health facilities to our neurological center, and its effects on outcome and hospital stay.

Patients and Methods

It was a prospective descriptive study of traumatic brain injury patients admitted and managed by our neurosurgical center from 1st November 2010 to 31st October 2013. Data was collected using structured proforma which was a component of our prospective Data Bank that was approved by our hospital Research and Ethics Committee. Data was collected in accident and emergency, wards and out-patient clinic. Biodata, time of trauma, etiology, place of first medical care, mode of presentation (DIRECT = from the scene, INDIRECT = referred from other health facilities), time patient arrived in accident and emergency, time neurosurgical unit reviewed the patient, Glasgow Coma Score after resuscitation, mode of treatment given, length of stay in the hospital, and Glasgow Outcome Score three months post-injury were collected. The functional outcome was assessed at three months post-injury as it had been found that the outcome at three months is the best predictor in long term.[5] Patients excluded from the study

ISSN 2073-9990 East Cent. Afr. J. surg

included those whose time of trauma or presentation were not known, patients that were not admitted, and those referred to our clinic for post-traumatic complications such as post-concussion syndrome, frontal lobe syndrome and post-traumatic seizures. The data was analyzed using Epi Info 7 software.

Results

Two hundred and twenty one patients qualified for the study. There were 166 males and 55 females. The age range was two months to 75 years with mean age of 28.08 years. Twenty to thirty year age group had the highest frequency (Table 1).

Table 1. Age Distribution

Age	Number	Percent (%)
0 -10	41	18.55
10 – 20	29	13.12
20 – 30	60	27.15
30 – 40	50	22.62
40 – 50	27	12.22
50 – 60	9	4.07
60 – 70	4	1.81
70 - 80	1	0.45
Total	221	100

One hundred and one patients (45.7%) came direct from the trauma scene (direct group), while 120 patients (54.3%) were referred from other health facilities (indirect group). The median time of reaching our accident and emergency was 2 hours for direct group and 20 hours for indirect group (Table 2). There was significant delay for the indirect group relative to the direct group $P = 0.0000$.

Table 2. Time Lag from Trauma Scene to Accident and Emergency.

DIRECT								
Time lag (hours)	Number	total	Mean	variance	Std dev	min	Median	Max
	101	444	4.40	146.78	12.12	1.00	2.00	94.00
INDIRECT								
Time lag (hours)	Number	total	Mean	variance	Std dev	min	Median	Max
	120	5077	42.31	3808.65	61.71	1.00	20.00	336.00

Table 3. Time Lag from Trauma Scene to Neurosurgical Care

DIRECT								
Time lag (hours)	Number	total	mean	variance	Std dev	min	median	Max
	101(45.7%)	1182	11.70	288.97	16.99	2.00	5.00	95
INDIRECT								
Time lag (hours)	Number 120(54.3%)	total 5793	mean 48.27	variance 3814.08	Std dev 61.75	Min 2.00	median 28.00	Max 337

ISSN 2073-9990 East Cent. Afr. J. surg

The median time from time of trauma to neurosurgical review was 5 hours for direct and 28 hours for indirect groups (Table 3). The median time between presentation in accident and emergency and neurosurgical review was 3 hours for direct and 2 hours for indirect group. The commonest etiology was road traffic accident (Table 4).

Table 4, Distribution of Causes of TBI

Etiology	Number	Percent (%)
Road traffic accident	158	71.49
Assault	26	11.76
Fall	24	10.86
Gun shot	4	1.81
Sports	2	0.90
Others	7	3.17
Total	221	100

One hundred and sixty nine patients (76.47%) were managed conservatively, while 52 (23.53%) had surgical care. Mode of treatment did not affect the overall outcome P= 0.0937. Favorable outcome (GOS ≥ 4) was 91.4% and mortality was 8.14%. The mortality among the direct group was 10.89% while the indirect group had 5.83%. There was no significant difference in outcome between the two groups P = 0.3969 (Table 5). The median hospital stay was 11days for direct group and 14 days for indirect group (Table 6) Mode of presentation did not have significant effect on hospital stay P = 0.5283.

Table 5. Mode of Presentation Versus Glasgow Outcome Score

Mode of presentation	Glasgow Outcome Score				
	1	3	4	5	Total
Direct	11(10.89%)	0 (0.00%)	11 (10.89%)	79 (78.22%)	101 (100%) 45.70%
Indirect	7 (5.83%)	1(0.83%)	11(9.17%)	101(84.17%)	120 (100%) 54.30%
Total	18 (8.14%)	1(0.45%)	22 (9.95%)	180 (81.45%)	221 (100%)
P = 0.3969					

Table 6. Hospital Stay

DIRECT								
Hospital stay (days)	Number	total	mean	variance	Std dev	min	median	Max
	101	1886	18.67	819.30	28.62	1.00	11.00	213.00
INDIRECT								
Hospital stay (days)	Number	total	mean	variance	Std dev	min	median	Max
	120	2095	17.46	276.10	16.62	1.00	14.00	122.00

ISSN 2073-9990 East Cent. Afr. J. surg

Discussion

We had 221 patients in our study with 75.11% males. High percentage of males in traumatic brain injury had been documented in many series.[2-4, 6-12] It had been attributed to high activities of males trying to fend for the families.

One hundred and one patients (45.7%) were transported from the trauma scene to the neurosurgical center while 120 patients (54.3%) were referred from other health facilities. The median time for direct group was 5 hours while in indirect group it was 28 hours. The arrival time for indirect group was significantly greater than the direct group $P = 0.0000$. These times were outside the North American guidelines which recommended a maximum of 4 hours from time of injury to neurosurgical attention for patients requiring hematoma evacuation.[13] In 170 patients studied in Auckland by Kejriwal et al[10] 57% came direct while 43% was indirect, and the median time was 50 minutes and 7 hours 3 minutes respectively. There was significant delay by the indirect group $P = 0.0001$. There was trauma system with patients from most distant referring hospital, 346km from Auckland, transferred via air ambulance. The neurosurgical center covered a population of approximately 2 million people. In 151patients studied in United Kingdom between 1982 and 1984 by Marsh et al,[12] 17 patients were direct while 134 patients were indirect. They found that patients remained average of 12hours in District General Hospital before neurosurgical unit was contacted. They also noted that the average ambulance journey was 20 minutes for hospitals less than 10 miles and 35 minutes for those greater than 20 miles. Their neurosurgical centers covered population of 1.5-3 million people. They had a ratio of one neurosurgeon to 500,000 of population then which had improved to 1:254,063.[14].

Our neurosurgical centre with one neurosurgeon covers two states and parts of three adjoining states all totaling approximately 7 million people and the city the center is located has population of 431,200 people.[15] We got referral from health facilities in these states. There was no trauma system. Patients were transferred by road and farthest areas are about 600km. It took average of 6 hours to bring some of the patients from far areas. Indirect group in our study was higher because majority of patients were living outside the city the neurosurgical center is located. The need to resuscitate these patients in the nearest hospital before referring to the neurosurgical center, and the distance covered to reach the neurosurgical center must have accounted for the significant delay in the indirect group. The time taken from arrival of these patients at the accident and emergency to neurosurgical team review (3 hours for direct and 2 hours for indirect) was unacceptably high. The delay in informing neurosurgical team when these patients arrived prompted this study. This is likely to transcend to other units. It serves as a clarion call for better organization of the accident and emergency.

In our study, there was no significant difference in functional outcome and mortality, and hospital stay among the two groups. Nathens et al[16] retrospectively studied 4,720 patients and found no significant difference in mortality and length of hospital stay in both direct and indirect groups. However, the cost of treatment was significantly higher in the indirect group. Raj et al[17] studied 431 patients and found median time of 1.07 hours for direct group and 4.06 hours for indirect group. There was no significant difference in mortality between the two groups. They believed that the delay was not long enough in their study. This belief was not supported by our study which had long delay (median was 5 hours for direct and 28 hours for indirect) but still no significant difference in mortality and hospital stay. Like our study there were more deaths among the direct group. Moen et al[8] also found more deaths among the direct group in their study. Their study as well as Nathens et al had more severe head injuries in patients admitted direct to neurosurgical center. In our study severe head injury was 19.80% in direct group and 22.17% in indirect group. The higher mortality among the direct group might

ISSN 2073-9990 East Cent. Afr. J. surg

have been due to the fact that many of them travelled long distances without resuscitation unlike the referred patients who were resuscitated in referring hospitals. Härtl et al[9] showed that patients transported indirectly to neurosurgical trauma center via a lower level of care hospital had a 50% higher risk of death than patients transported direct. Many authors also found higher mortality among referred group.[18-21] That had been attributed to presence of trauma system[22-24] which helped in faster transfer of patients to neurosurgical centers. This is supported by finding that the presence of trauma system has been associated with decreased mortality and improved outcomes by potentially speeding up transfer of trauma patients to a major trauma center.[23,24] However, Sollid et al[25] studied 85 severe head injury patients in which 47 was transported direct to neurosurgical center and 37 referred from other hospitals. They found more deaths (34%) and lower favorable outcome (53%) among direct group compared to mortality of 26% and favorable outcome of 58% among the referred patients. The difference among the groups was not statistically significant.

Myburgh et al[26] studied prospectively 635 adult patients with TBI in a trauma system and adherence to international guidelines, and found mortality and favorable outcome similar to data published before the advent of guidelines. They concluded that the mortality was likely from pre-hospital secondary brain insult and ageing population. They advised that strategies should be directed at preventive public health strategies and intervention to minimize secondary brain injuries in the pre-hospital period. This advice is apt considering that the study by Thibault et al[27] on 297 patients on pre-implementation, implementation, and post-implementation of guidelines failed to improve times to neurosurgical care. The implementation of these guidelines has also been very poor. A Canadian study found fewer than 40% of physicians changed their practice on the basis of any guidelines.[28] In United States, only 16% of centers achieved full guideline compliance on the management of severe traumatic brain injury in 2002.[29] Chafi et al[30] in their current publication still found suboptimal adherence to guidelines in America with overall average of 73%.

Conclusion

Our study showed that majority of our patients was referred from other health facilities. There was significant delay in patients accessing neurosurgical care in our center by patients referred from other health facilities compared to those coming to us from trauma scene. Our result showed that there was no significant difference in mortality and hospital stay among patients coming direct from trauma scene and those referred from other health facilities.

Recommendation

Upgrading general hospital facilities such as provision of CT scans and Telemedicine facilities will help Doctors in general hospital to communicate with neurosurgeons in neurosurgical centers for quick evaluation of patients and quick institution of appropriate treatment. . More attention should be paid to prevention of secondary brain injuries from the accident scene to the definitive neurosurgical care.

Establishment of trauma system with air and land ambulances will help faster transfer of patients to neurosurgical centers for appropriate and adequate treatment. Urgent steps have to be taken to reduce the time taken to review patients in accident and emergency. The hospital should provide communication gadgets to accident and emergency unit, and other units for prompt communication and quick response.

References

1. Polinder S, Meerding WJ, Mulder S, Petridou E, van Beeck E, EUROCOST Reference Group. Assessing the burden of injury in six European countries. Bull World Health Organ 2007.85:27-34.
2. Polinder S, Meerding WJ, van Baar ME, Toet H, van Beeck EF, EUROCOST Reference Group. Cost estimation of injury-related hospital admissions in 10 European countries. J Trauma 2005.59:1283-90.
3. Badjatia N, Carney N, Crocco TJ, Fallát ME, Hennes HM, Jagoda AS et al. Guidelines for pre-hospital management of traumatic brain injury. 2nd edition. Prehosp Emerg Care 2008;12(Suppl1):S1-52.
4. Mackenzie EJ, Rivara FP, Jurkovich GJ, Nathens AB, Frey KP, Egleston BL, et al. A national evaluation of the effect of trauma-center care on mortality. N Engl J Med. 2006;354:366-78.
5. King TJ, Carlier PM, Marion WD. Early Glasgow Outcome Scale scores predict long-term functional outcome in patients with severe traumatic brain injury. Journal of Neurotrauma 2005; 22:947-54.
6. Jiang J, Gao G, Li W, Yu W, Zhu C. Early indicators of prognosis in 846 cases of severe traumatic brain injury. J Neurotrauma 2002;19:869-74.
7. Jacobs B, Beems T, Stulemeijer M, van Vugt AB, van der Vliet TM, Born FG, et al. Outcome prediction in mild traumatic brain injury: age and clinical variables are stronger predictors than CT abnormalities. J Neurotrauma 2010;27:655-68.
8. Moen KG, Klepstad P, Skandsen T, Fredriksli OA, Vik A. Direct transport versus inter-hospital transfer of patients with severe head injury in Norway. Eur J Emerg Med 2008;15:249-55.
9. Härtl R, Gerber LM, Iacono L, Ni Q, Lyons K, Ghajor J. Direct transport within an organized state trauma system reduces mortality in patients with severe traumatic brain injury. J Trauma 2006;60:1250-56.
10. Kejriwal R, Civil I. time to definitive care for patients with moderate and severe traumatic brain injury — does a trauma system matter? N Z Med J 2009;122:40-46.
11. Holmen CD, Sosnowski T, Latoszek KL, Dow D, Rowe BH. Analysis of pre-hospital transport of head-injured patients after consolidation of neurosurgery resources. J Trauma 2002;53:345-50.
12. Marsh H, Maurice-Williams RS, Hatfield R. Closed head injuries: where does delay occur in the process of transfer to neurosurgical care? Br J Neurosurg 1989,3:13-20.
13. Brain Trauma Foundation. Surgical management of traumatic brain injury. Neurosurg 2006; 58(Suppl):S2-62
14. American Association of Neurological Surgeons. Comparison of neurosurgical demographics for developed countries. Nuerosurg 2008;17:6-7.
15. National Population Commission of Nigeria. 2006 population census. www.population.gov.ng
16. Nathens AB, Maier RV, Brundage SI, Jurkovich GJ, Grossman DC. The effects of inter-facility transfer on outcome in an urban trauma system. J Trauma 2003;55:444-9.
17. Raj R, Siironen J, Kivisaari R, Kuisma M, Brinck T, Lappalainen J, et al. Factors correlating with delayed trauma center admission following traumatic brain injury. Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine 2013;21:67.
18. Seelig JM, Becker DP, Miller JD, Greenberg RP, Ward JD, Choi SC. Traumatic acute subdural hematoma: major mortality reduction in comatose patients treated within four hours. N Engl J Med 1981;304:1511-18.
19. Haselsberger K, Pucher R, Auer LM. Prognosis after acute subdural or epidural hemorrhage. Acta Neurochir(Wien) 1988;90:111-16.

20. Wright KD, Knowles CH, Coast TJ, Sutcliffe JC. 'Efficient' timely evacuation of intracranial hematoma: the effect of transport direct to a specialist centre. Science direct 1996 Dec; 27: 719-21.
21. Stone JL, Lowe RJ, Jonas son O, Baker RJ, Barrette J, Older haw JB, et al. Acute subdural hematoma: direct admission to a trauma center yields improved results. J Trauma 1986;26:445-50.
22. Harrington DT, Connolly M, Biffl WL, Majercik SD, Cioffl WG. Transfer times to definitive care facilities are too long: a consequence of an immature trauma system. Ann Surg 2005;241:961-8.
23. Mullins RJ, Mann NC, Hedges JR, Worrall W, Jurkovich GJ. Preferential benefit of implementation of a statewide trauma system in one of two adjacent states. J Trauma 1998;44:609-17.
24. Young JS, Bassam D, Cephas GA, Brady WJ, Butler K, Pomphrey M. Inter-hospital versus direct scene transfer of major trauma patients in a rural trauma system. Am Surgeon 1998;64:88-91
25. Sollid S, Munch-Ellingsen J, Gilbert M, Ingebrigtsen T. Pre- and inter-hospital transport 0f severely head-injured patients in rural Northern Norway. J Neurotrauma 2003;20:309-15.
26. Myburgh JA, Cooper DJ, Finfer SR, Venkatesh B, Jones D, Higgins A, et al. Epidemiology and 12-month outcomes from traumatic brain injury in Australia and New Zealand. J Trauma 2008;64:854-62.
27. Thibault-Halman G, Tallon JM, Ackroyd-Stotarez S, Fenerty L, Karim AS,Sealy B, et al. Major traumatic brain injury: time to tertiary care and the impact of a clinical guideline. J Trauma 2011;70:1134-40.
28. Hayward RS, Guyatt GH, Moore KA, Mckibbon KA, Carter AO. Canadian physicians' attitudes about and preferences regarding clinical practice guidelines. CMAJ 1997;156:1715-23.
29. Hesdorffer DC,Ghajar J, Iacono L. Predictors of compliance with the evidence-based guidelines for traumatic brain injury care: a survey of United States trauma centers. J Trauma 2002;52:1202-09.
30. Chafi S, Barnes SA, Millar D, Sobrino J, Kudyakov R, Berryman BS et al. Suboptimal compliance with evidence-based guidelines in patients with traumatic brain injury. J Neurosurg 2014;120:773-7.