

**INTRACRANIAL FINDINGS IN HEAD INJURY  
PATIENTS WHO DIED AT THE  
UNIVERSITY TEACHING HOSPITAL LUSAKA,  
ZAMBIA.**

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## **ABSTRACT**

The purpose of this study was to determine the missed diagnosis of potentially treatable intracranial lesions in patients who died of head injury.

Two hundred and fifty three patients were admitted to the University Teaching Hospital with head injury in 1996, of these eighty (31.6%) died. Fifty four (67.5%) had autopsy and the incidence of intracranial haemorrhage was forty eight (88.9%). Of the 54 deaths, where autopsy was done, 10(19%) had favourable prognostic factors such as a glasgow coma scale of 6-14 and minor body injuries and were therefore salvagable by aggressive, investigation and management facilities. Intracranial lesions are easily detected by diagnostic radiology such as Carotid Angiography and Computerised Tomography scanning which are lacking at this hospital.

Only seven of the eighty patients who died had localising signs on admission and two had exploratory burr hole surgery. In the remaining five cases surgery was not done due to inadequate evaluation.

In a major referral hospital such as the University Teaching Hospital, it is important that the services provided are backed by proper diagnostic facilities if patient care is to improve.

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## **INTRODUCTION**

Intracranial haemorrhage is the commonest mass lesion associated with head injury. In a study of one hundred and eleven head injured patients, with Glasgow Coma Scale of 3 on admission, seventy four percent had intracranial haematoma diagnosed on Computerised Tomography Scanning, (Kotwica and Jakubowski, 1995)).

Due to poor investigative facilities, in most developing countries, the type of intracranial lesions is not known until an autopsy is performed. In many countries where resources are lacking, severely head injured patients (Glasgow Coma Scale 3 - 5) who usually present with no localising signs have often been given supportive management only and rapidly die. Thus in departments where resources are limited, therapy can be inadequate or no therapy is offered to these severely head injured patients. (Kotwica and Jakubowski, 1992).

The advances in diagnostic radiology have greatly improved the treatment of the head injured patient in the western world. However, in the third world countries such as Zambia where even Carotid Angiography is difficult to obtain, the management of these head injured patients relies heavily on the clinical assessment and competence of the attending doctors. This study addresses the outcome or missed diagnosis of head injury patients dying in such an environment and assesses whether the lesions seen at autopsy were potentially salvageable if detected prior to death.

## LITERATURE REVIEW

The management of head injury patients in the third world poses a great challenge to the general surgeon who has to fill in the vacuum left by the lack of the services of a neurosurgeon and many other specialists. Miller J. Douglas (1980) did a survey and showed that the neurosurgeon: patient ratio was 1:75,000 in the United States of America, 1:140,000 in Canada, 1:400,000 in the United Kingdom and 1:3,000,000 in the continent of Africa. Despite this alarming ratio of neurosurgeon to patient, head injuries form a large percentage of hospital admissions in Africa and the world over; 30% in Zambia (Buchana 1971), 20% in Kenya (Luther and Rubert 1976), 25% in Uganda (De Souza 1968) and 40% in Morocco (El Khamlichi 1975). It is estimated that one person dies of head injury every 12 minutes and that 50% of all trauma deaths are associated with head injury. (Zambia Trauma Course as adopted by the Surgical society of Zambia 1996.)

Intracranial haemorrhage is a common complication of blunt head injury and frequently occurs in patients suffering only minimal impact or damage (Louis Bakay and Franz E Glasauer 1980). Gentleman, et al (1992) reported that in 270 patients who died of head injury in a Glasgow hospital, 31% had significant intracranial haematomas at autopsy and 7 of those might have been salvaged by neurosurgical intervention. In most series where autopsies are done on patients dying of head injury, extradural haematoma accounted for 20% of the mortality rate and, most of these are salvageable by surgery (de Miranda 1987) In an analysis of 211 cases studied with Computerized Tomography of head injured patients in those who talk and later deteriorate into coma, the incidence of extradural haematoma was 21.8% (Lobato et al 1991).

Traumatic acute subdural haematoma is one of the most lethal of all head injury complications. The mortality rate is reported to be between 50 and 90%. In a review of 1688 cases, 127 (7.5%) had acute subdural haematoma on admission and required surgery (Massaro, et al 1996). Lobato et al (1991) found the incidence of subdural haematoma to be 16.6% in his analysis of 211 patients with head injury, while the incidence of intracerebral haematoma was 46%. Although various types of intracranial haemorrhage have been described as individual entities, it is important to realize that the patient may have two or more of these lesions simultaneously (Louis Bakay and Franz E. Glasauer 1980).

In spite of the well-described clinical features of head injury complications, in many parts of Africa, cases of extradural haematoma are still discovered in the autopsy room rather than in the operating theatre (Adelola Adeloye 1989). Most deaths in Africa are not subject to autopsy due to traditional beliefs and costs of funerals which makes the relatives of the deceased reluctant to give consent. A study dealing with head injuries at the University Teaching Hospital, Lusaka showed that out of 21 patients with various types of intracranial haemorrhages, 12 died but non of these had autopsies (Boone 1991). Lack of Pathological services also contributes to the lack of autopsies in most third world countries. Verma and Watters (1987) reported a mortality rate of 7.8% in head injury patients at University Teaching Hospital intensive care unit but no autopsies were done.

Computerized tomography has revolutionised the management of head injury in the developed world. It is a safe, non-invasive, and generally cost-effective means of assessing patients at risk of developing intracranial complications. ( Vollmer and Darcey Jr. 1991). Stein and Rose (1992) reviewed records of 1538 mild head injury over a four and a half year period and concluded that clinical observation with or without skull x-ray films is inadequate to rule out potentially dangerous intracranial lesions in apparently mild head injuries. They further noted that in patients with a history of loss of consciousness or amnesia, an immediate computerized tomography scan is indicated.

**OBJECTIVE**

To study the types of intracranial lesions in head injury patients who died at the University Teaching Hospital and determine whether these patients would have been potentially salvageable had the lesions been detected prior to death.

**RATIONALE**

In view of the non existence of investigative facilities at this hospital and the inadequate neurosurgical services available, this study was designed to determine whether the types of lesions seen in the head injured patients could have been salvageable if they were detected in time. At present not even the 22 years old Carotid Angiography X-ray machine is functional. The diagnosis of the type of intracranial lesions in these head injured patient solely depends on the clinical assessment of the doctor. Therefore the question arises as to whether we are missing potentially treatable lesions due to inadequate diagnostic facilities and poor neurosurgical evaluation

## PATIENTS AND METHOD

A prospective case control study was carried out, over a one year period from January to December 1996, at the University Teaching Hospitals' departments of Surgery and Pathology respectively. Cases comprised of patients who were admitted and later died of head injury in the hospital. Autopsies were performed on the subjects after obtaining consent from the next of kin or the police as the case may be. Autopsies were done by the three hospital pathologists or by the Senior House Officer in pathology and the project author in the presence of one of the three pathologists.

The autopsies involved initial gross examination of the whole body and noting any abnormalities or surface markings. The bodies were then opened and the viscera removed en mass and examined individually. The organs were sectioned for in depth examination. The skulls were opened with an electric saw and the contents i.e. the brain and membranes examined grossly. The brain was then removed and examined separately. The brain was sectioned to look for intracerebral and intraventricular haemorrhages. The base of the skull was examined after removal of the brain. The findings were recorded on the proforma and the official hospital postmortem forms. When the autopsy was complete the bodies were sutured and prepared for burial.

## RESULTS

During the one year period i.e. January to December 1996, two hundred and fifty three patients were admitted to the University teaching Hospital with head injury, out of whom eighty died giving a mortality rate of 31.6%. The age ranged between one year three months to seventy five years and the male : female ratio was 7:1. There were seventy six adults and four children.

Autopsies were done in fifty four cases (67.5%) while the remaining twenty six (32.5%) cases, nine were unidentified subjects and in the other seventeen consent was denied.

The incidence of intracranial haemorrhage was forty eight (88.9%) out of the fifty four cases where autopsy was conducted. Of these twenty eight (51.9%) had intracranial haemorrhage with minor body injuries; twenty (37.0%) had intracranial haemorrhage with other major multiple organ injury, four (7.4%) had brain oedema, while one case (1.85%) had normal intracranial findings at autopsy and another case had odontoid and burst atlas fracture, (1.85%)



**Table 2 Type of Intracranial haemorrhage and associated Skull fracture.**

TYPE OF HAEMORRHAGE	MINOR BODY INJURY		MAJOR MULTIPLE ORGAN INJURY		TOTAL	%
	+ SKULL #	- SKULL #	+ SKULL #	- SKULL #		
IC	5	03	07	05	20	41.7
SD	02	04	01	01	08	16.7
E+SD+IC	06	-	-	-	06	12.5
SD+IC	01	02	03	01	07	14.6
SD+SA	01	02	01	01	05	10.4
SD+SA+IC	01	-	-	-	01	2.1
E	-	01	-	-	01	2.1
<b>TOTAL</b>	<b>16</b>	<b>12</b>	<b>12</b>	<b>08</b>	<b>48</b>	<b>100</b>

**Key**

\*\*\* *IC Intracerebral*

*SD Subdural*

*E Epidural*

*SA Subarachnoid*

+ *with*

- *without*

# *Fracture*

- Majority of the cases with minor body injuries and intracranial haemorrhages had associated skull fractures.

Of the patients who died of head injury, seven had lateral localising signs and surgery was planned in five of these cases, however, only two had exploratory burr holes and subdural haematomas were found in these two. All seven patients died and three had autopsies including the two who had surgery, and gross subdural haematomas were found in all three.

The Glasgow Coma Scale on admission for the 54 cases who had autopsies ranged between 3 and 14. See table 3. It was found that thirty nine (72.2%) had severe head injury (Glasgow Coma scale (3-5)), while twelve (22.2%) had a moderate head injury (Glasgow Coma Scale 6-9) and three (5.3%) had mild head injury (Glasgow Coma Scale 10-14.)

**Table 3 Glasgow Coma Scale and type of Intracranial findings and associated injuries.**

<b>GSC</b>	<b>ICH WITH MINOR BODY INJURY</b>	<b>ICH WITH MAJOR MULTIPLE ORGAN INJURIES</b>	<b>CEREBRAL OEDEMA</b>	<b>NORMAL IC FINDINGS</b>	<b>O.F. WITH BURST ATLAS</b>	<b>TOTAL</b>
3-5	18	17	02	01	01	39
6-9	08	02	02	-	-	12
10-14	02	01	-	-	-	03
<b>Totals</b>	<b>28</b>	<b>20</b>	<b>04</b>	<b>01</b>	<b>01</b>	<b>54</b>

**KEY**

*ICH* - *Intracranial Haemorrhage*

*IC* - *Intracranial*

*O.F* - *Odontoid fracture*

- The majority of the patients had severe head injury (glasgow Coma Scale 3 - 5) in the fifty four where autopsy was performed.

Road Traffic Accident was top on the list for the mode of injury followed by assault see table 4

**Table 4** **Mode of Injury and Number of Cases**

<b>MODE OF INJURY</b>	<b>AUTOPSY CASES</b>	<b>TOTAL CASES</b>
Road Traffic Accident	34	54
Assault	16	20
Train Accident	02	03
Domestic Accident	01	01
Gun Shot	01	01
<b>Total</b>	<b>54</b>	<b>80</b>

\*\*\* *Road Traffic Accident was the leading mode of injury followed by Assault.*

\*\* Perhaps its worth of note that in the past four years Lusaka's number of vehicles on the road has increased, and together with the increasing population and bad state of most roads, has lead to increased Road Traffic Accidents and head injuries.

## DISCUSSION

Various forms of intracranial haemorrhage were found in forty eight (88.9%) of the fifty four cases in whom autopsy was performed. In twenty eight (51.9%) of the cases the intracranial haemorrhage was with minor body injury implying that had the lesions been detected, these patients would have been potentially salvageable. However this was not so because almost all presented with no localising signs and hence the lesions were missed clinically. It must also be stated that merely detecting the lesion that is amenable to surgery does not mean that the outcome is favourable. Other factors such as severity of the head injury at impact are also important in the outcome of these cases. Only 10(19%) out of the 54 deaths had a favourable Glasgow coma scale (6-14) with minor body injury and hence could have been salvaged by aggressive investigation and management (see table 3 of results).

The other twenty (37.0%) cases with intracranial haemorrhage had major multiple organ injury confirmed at autopsy. In this group, even if the intracranial haemorrhage had been treated surgically the prognosis would still have been poor due to the multiple organ injuries.

However in both of these two groups the intracranial lesions were not detected prior to death due to lack of diagnostic facilities. Intracranial haemorrhages are mass lesions and are easily detected by Carotid Angiography which is affordable in developing countries. Between April 1993 and November, 1995, one hundred and twenty six Carotid angiographies were done at the University Teaching Hospital of which fifty two were in head injury patients and seventy four for other indications. Nineteen (36.5%) of the head injured patients had intracranial haemorrhage detected by Carotid Angiography and underwent surgery. (Neurosurgical mortality, morbidity figures 1993 - 1995, University Teaching Hospital Department of Surgery). Presently the twenty two years old x-ray machine for Carotid Angiography is non functional.

The incidence of intracranial haemorrhage in the head injured patient has been reported to be high in other series. Ciricillo et al (1992) in Italy found an incidence of 72% of intracranial haemorrhage in patients with closed head injury. Kotwica and Jakubowski (1995) in Poland found 74% incidence of intracranial haemorrhage with subdural haemorrhage topping the list. In these two studies computerized tomography was used to diagnose the intracranial findings. In our study almost all the lesions were found in the autopsy room and only two at the operating table.

Skull fractures were found in twenty eight of the forty eight cases with intracranial haemorrhage of which sixteen were in those with minor body injury and twelve in those with major multiple organ injury. Even though skull fractures are not an indicator of the severity of the intracranial lesion, their presence however indicates that considerable force was applied to the cranium.

In seven of the cases where indication for surgery was apparent by the presence of lateral localizing signs only two had exploratory Burr Holes done. The other five cases, surgery was not done because of inadequate neurosurgical knowledge of the attending doctor. In the Polish study (Kotwica and Jakubowski 1995) surgery was done on all of the 74% of patients who had intracranial haemorrhage detected by Computerised Tomography. This goes to show that there is need to strengthen the neurosurgical service and knowledge of the doctors attending to these head injury patients.

Ciricillo et al (1992) evaluated two hundred and twenty five consecutive patients with intracranial haematomas requiring surgery and found the following incidence of the various types of haemorrhage: Subdural haematoma 45%, Epidural 8%, Intracerebral 10% and Cerebral contusions 9%. He reported a 51% mortality rate and 13% vegetative state and 35% had good outcome. In our study the incidence of Subdural haematoma in total was 54.3%, and 16.7% as a single entity.

Epidural 14.6% and subarachnoid 12.5% in total whereas intracerebral as a single lesion was 41.7% and 29.2% in combination with other lesions. This high incidence of intracerebral haemorrhage may be attributed to the severity of the head injury and the presence of skull fractures in the majority of the cases. Lobato et al (1991) also reported a high incidence of intracerebral haemorrhage (46%) and subdural haemorrhage (16.6%) in his study of two hundred and eleven head injured patients.

Massaro et al (1996) found that the most important prognostic variables in patients with traumatic acute subdural haematoma was the computerized tomography findings and the Glasgow Coma Scale. Low points on the Glasgow Coma scale carried poor prognosis. Hatashita et al (1993) in Japan found a mortality rate of 33% in patients with coma scale of 3 on admission. Ratanalert and Phuenpathorn, (1990) in Thailand reported a mortality rate of 40% in severe head injured patients. At the University Teaching Hospital, in Lusaka, Zambia, fifty patients with severe to moderate head injury out of the two hundred and three admitted with head injury died in 1995 giving a mortality rate of 24.6%. In our study 72.2% of the patients who died and had autopsy done, had glasgow Coma Scale between 3-5 with an overall mortality rate of 31.6% out of the two hundred and fifty three patients admitted with head injury. Similarly as in many other series, Road Traffic Accidents accounted for the majority of head injuries in our study. See table 4.

## CONCLUSION

From this study the following can be concluded:

1. 19% of the 54 deaths with Head Injury had intracranial pathology that was potentially salvageable by surgery.
2. Potentially salvageable intracranial lesions are being missed due to the non availability of diagnostic facilities such as Carotid Angiography and Computerised Tomography.
3. Inadequate neurosurgical knowledge and inappropriate management lead to death in seven patients who had localising signs on admission.
4. There is need to acquire a new X-ray machine for Carotid Angiography and also to strengthen the neurosurgical coverage of the general surgical units.

APPENDIX 1

TABLE 5. Proforma for Data Collection

HEAD INJURY AT UTH

NAME:.....FILE NO.....

AGE:.....SEX.....SURVEY NO.....

DATE:.....MODE OF INJURY.....

DIAGNOSIS:.....

OTHER ASSOCIATED INJURIES:.....

GLASGOW COMA SCALE:.....

DATE OF DEATH:.....

CLINICAL CAUSE OF DEATH:.....

.....

.....

AUTOPSY FINDINGS:.....

.....

.....

.....

.....

CAUSE OF DEATH:.....

.....

.....

**APPENDIX 2****Definitions**

<i>Autopsy:-</i>	The examination of a dead body for diagnostic purposes.
<i>Burr Hole:-</i>	A trephine hole in the cranium.
<i>Extradural Haemorrhage:-</i>	Bleeding occurring external to the dura mater.
<i>Glasgow Coma Scale:-</i>	Clinical Scale used to assess the level of consciousness and quantify the degree of coma.
<i>Intracerebral Haemorrhage:-</i>	Bleeding within the cerebrum
<i>Intracranial Haemorrhage:-</i>	Bleeding within the cranium.
<i>Subarachnoid Haemorrhage:-</i>	Bleeding in the Subarachnoid space.
<i>Subdural Haemorrhage:-</i>	Bleeding in the subdural space.

## REFERENCES

1. **Adelola Adeloye, (1989).** Neurosurgery in Africa First Edition. Ibadan University Press Page 42.
2. **Boone D., (1991).** Critical care of multiple trauma victims in Lusaka. The Proceedings of the Association of Surgeons of East Africa. Vol 14:21-27.
3. **Buchana D.J., (1972).** Trauma at Ndola Central Hospital, an analysis of six months admissions. Med J. Zambia 5, 183-191.
4. **Ciricillo S.F., Andrews B.T., Damion S.L., Pitts L.H., (1992).** Severity and outcome of intracranial lesions in pedestrians injured by motor vehicles. Journal of trauma 33(6): 899-903.
5. **De Souza L.J., (1986).** The pattern of Trauma at Mulango National Hospital, Kampala, East African Medical Journal 42:522.
6. **De Miranda H., (1987).** Surgically explored head injuries at Quehniene provincial Hospital. The proceedings of the Association of Surgeons of East Africa Vol 10:109-110.
7. **El-Khamilich A, J. Hermo, (1975).** Bilan de 10 and de neuro-traumatologie cranienne au service de Neurochirurgie de L'hopitale Avicenne C.H. W. de Rabat-Sale. Annales Medico chirurgicales d'Avicenne, Jan-Feb. 39-77.
8. **General Surgery Mortality, morbidity figures, (1995).** University Teaching Hospital, Department of Surgery School, of Medicine, University of Zambia.
9. **Gentleman D., Jennett B., MacMillan R., (1972).** Death in Hospital after head injury without transfer to a neurosurgical unit; who when and why? British Journal Of Accident surgery. 23(7) 471-474.

10. *Hatashita S., Koga N., Hosaka Y., Takagi S., (1993).* Acute Subdural haematoma: Severity of injury, surgical intervention and mortality *Neurologia Medico-Chirurgica.* 33(1):3-8.
11. *Kotwica Z, Jakubowski J.K. (1992).* Acute head injuries in the elderly. An analysis of 136 consecutive patients. *Acta neurochirurgica* 118(3-4): 98-102.
12. *Kotwica Z, Jakubowski J.K., (1995).* Head injured adult patients with Glasgow Coma Scale of 3 on admission who have a chance to service. *Acta Neurochirurgica* 133 (1-2). 56-59.
13. *Louis Bakay and Glasauer F.E., (1980),* Head injury. First Edition: Little Brown and Company Boston, Page 1 and 2.
14. *Lobato R.D. Rivas J.J., Gomez P.A. Costabeda M. Canizal J.M. Sarabia R., Cabrena A. Munoz M.J., (1991).* Head injured patients who talk and deteriorate into come. Analysis of 211 cases studied with Computerized Tomography. *Journal of Neurosurgery* 75 (2): 256-61.
15. *Luther R.F., Ruberti R.F., (1976).* A review of the pattern of head injuries at the Kenyatta National Hospital, Nairobi. *Medicine D'Afrique Noire* 231:101-107.
16. *Massaro F., Lonotte M., Farcani G, Triolo C., (1996).* One hundred and twenty-seven cases of acute subdural haematoma operated on correlation between Computerized Tomography Scan findings and Outcome. *Acta Neurochirurgica* 138 (2) 185-91.
17. *Miller J. Douglas, (1980).* A European look at neurosurgery in America. *Acta Neurochirurgica* 54:3-16.

18. ***Neurosurgical mortality, morbidity figures (1993-1995)***  
University Teaching Hospital Department of Surgery, School of Medicine, University of Zambia
19. ***Personal series, (1996)***. University Teaching Hospital Lusaka Zambia. Unpublished material.
20. ***Ratanalent S. Phuenpathorn N., (1990)***. Management of head injury patients who talked and deteriorated. *Surgical Neurology* 34(1) 27-9
21. ***Stein S.A., Rose S.E., (1992)***. Mild head injury; a plea for routine early C.T. scanning *Journal of Trauma* 33 (3):11-3
22. ***Verma R.J., Watters D.A.K., (1987)***. A prospective study of Head injuries admitted to a Central African Teaching Hospital. *Proceedings of the Association of Surgeons of East Africa* Vol 10:106-108.
23. ***Vollmer D.G., Dacey R.G. Jr., (1991)***. The management of mild and moderate head injuries (review). *Neurosurgery Clinics of North America* 2 (2): 437-55.
24. ***Zambia Trauma Management Course, (1996)***. As adopted by the Surgical Society of Zambia. University Teaching Hospital, Department of Surgery Lusaka, Zambia.