THE UTILITY OF CT OPTIC NERVE SHEATH DIAMETER IN PATIENTS WITH TRAUMATIC BRAIN INJURY REFERRED TO MUHIMBILI NATIONAL HOSPITAL

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MMed (Radiology) Dissertation
Muhimbili University of Health and Allied Sciences
October,2017

Muhimbili University of Health and Allied Sciences

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By

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A Dissertation/ Thesis Submitted in (partial) Fulfillment of the Requirement for the Degree of Master of Science (Radiology and Imaging) of the

Muhimbili University of Health and Allied Sciences
October, 2017

CERTIFICATION

The undersigned certify that they have read and hereby recommend for acceptance by Muhimbili University of Health and Allied Sciences a dissertation entitled; **"The utility of CT optic nerve sheath diameter in patients with traumatic brain injury referred to Muhimbili National Hospital, Dar es salaam Tanzania",** in (partial) fulfillment of the requirements for the degree of Master of Medicine Radiology of Muhimbili University of Health and Allied Sciences.

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Date

DECLARATION AND COPYRIGHT

I, **Veronica H. Lyandala**, hereby declare that this **dissertation** is my original work and that it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature: …… **Date**:…….

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ACKNOWLEGMENT

I am so grateful and humbled before the Almighty God for giving me a gift of life and good health throughout the time at MUHAS. Also my sincerely thanks goes to my employer Tanzania Peoples Defence Forces for sponsoring my studies and research up to this time.

I would also extend my gratitude to the management of MUHAS and Muhimbili National Hospital for supporting my MMed degree program and providing study setting for my research work. Furthermore I have to express my special thanks to all lecturers at the department of Radiology MUHAS for accepting my research topic and their special and tireless work throughout the study period. This goes to Dr. Kazema, Dr. Balowa, Dr. Mboka and Dr. Nkhurumbi.

Special thanks goes to Dr Lulu Fundikira as a head of department and my supervisor and Dr. Hamisi Shabani as co supervisor for their time and unconditional help whenever I needed them throughout the study period.

I wish to acknowledge the assistance from radiology department from MNH under Dr Flora Lwakatare as head of department, all radiologists and technologists for their support whenever I needed them.My further appreciations extend to Dr. M Mango, Head of MOI Radiology Department, Dr. Bwemelo, Dr Majda and all the staff of Radiology Department.

Also a vote of thanks goes to all my class mates for the unconditionally cooperation throughout my stay at MUHAS. Special thanks go to Mr.Ismail Mohamed for his statistical work and advices.

Lastly I would like to thank my family especially my parents Mr. and Mrs. Henry Lyandala, my sister Mrs. Yustina and her family and Rev. Florence Mbago and family for making sure thatam achieving my dreams.

DEDICATION

I dedicate this study to mylate sister REGINA HENRY LYANDALA who died following surgical complications due to Pituitary tumor.

ABSTRACT

Background

Traumatic brain injury is a major public health problem in Tanzania and indeed worldwide. Many concerns that arise from different research are that neurological damage from Traumatic Brain Injury does not occur at the moment of injury but occurs after hours and day's [1].The rise in Intracranial Pressure is considered an integral part in the pathophysiology of traumatic brain injury. ICP monitoring is crucial in management of TBI [2, 3].Recent cranial Computed Tomography scan studies have shown relationship between CT Optic Nerve Sheath Diameter and Intracranial Pressure [4,5,6,7]. Various non invasive methods have been used to measure signs of raised ICP like fundoscopy and ocular ultrasound of which the results are operator dependent [8,9,10]. To date little is known in this study area in our community. This study wasassessing the utility of CT scan Optic Nerve Sheath Diameter as a measure of raised intracranial pressure in patients with TBI and the findings will help the clinicians in the triaging patients at risk of having raised ICP.

Broad objective

To determine utility of CT Optic Nerve Sheath Diameter in patients with Traumatic Brain Injury referred to CT unit Muhimbili National Hospital from June 2016 to December 2016.

Methodology

This was a prospective Hospital based Cross sectional study which was conducted at Radiology department, Muhimbili National Hospital from June to December 2016 among head injury patients referred to CT scan unit.Structured questionnaire were used for recording patient's demographics, clinical information and Brain CT scan findings. Finally, a systematic dataanalysis was done and Statistical Association was done by using cross tabulations; Chi-square test was used to compare proportions. P value of < 0.05 was considered statistically significant.

Results

Two hundred and twelve patients with traumatic brain injury whom underwent head CT scan were included in this study, in which 175(82.5%) were male and 37(17.5%) were female. The participants mean age was 33.26 years with range of 18-76 years and standard deviation of 11.7. This study shows that patients with abnormal ONSD were 83 (39.2%) with mean ONSD of 0.6cm and mean GCS of 12 respectively which was statistically significant P=0.0011. Cutoff value of > 0.57cm was used. Sixty percent of patients with linear and depressed fractures significantly contributed more to the traumatic brain injuries and abnormal ONSD [P=0.0001 each].The secondary complications of traumatic brain injury like brain edema,midline shift, effacement of cistern and ventricles were all significantlyrelated to abnormal ONSD with the Pvalue of <0.001. There was strong relationship [P=0.0001] between GCS and ONSD among TBI patients where bymore than 60% of patients with severe and moderate TBI had abnormal ONSD.

Conclusion

Based on these study findings there is strong relationship between Glasgow Coma Scale and CT Optic Nerve Sheath Diameter in patients with Traumatic Brain Injury. Patients with moderate and severe TBI have higher ONSD measurements than mild TBI patients. In a limited setting CT ONSD obtained from initial scan can be used in triaging patients at risk of having raised ICP. ONSD measurement is indicated in patients with moderate and severe TBI than mild TBI.

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LIST OF ABBREVIATIONS

CSF	Cerebral Spinal Fluid
CT	Computed Tomography
GCS	Glasgow Coma Scale
MNH	Muhimbili National Hospital
MOI	Muhimbili Orthopaedic Institute
MRI	Magnetic Resonance Imaging
MUHAS	Muhimbili University of Health and Allied Sciences
TBI	Traumatic Brain Injury
RTI	Road traffic injury
FIG	Figure
SAS	Sub archnoid space
ONSD	Optic nerve sheath diameter
SA	South Africa
RTA	Road traffic accident
GWR	Gray matter to white matter ratio
USA	United States of America
ICP	Intracranial pressure
CBF	Cerebral blood flow
MDCT	Multidetector computed tomography
RCT	Rotterdam computed tomography
MM	Millimeter
CM	Centimeter

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Traumatic brain injury is among the injuries which are most likely going to result in death or permanent disability. Traumatic Brain Injury is a contributory factor to 30% of all injuries related deaths in the United States[11]. Patients with moderate and severe Traumatic Brain Injury require hospitalization. Computed tomography (CT) is the preffered imaging modality in diagnosis and management of all patients with Traumatic Brain Injury which requires neurosurgical intervention[12].

TBI severity is described by using Glasgow Coma Scale which is a clinical tool designed to assess coma and impaired consciousness, it is among the commonly used severity scoring systems. Patients with Glasgow Coma Scale of 3 to 8 are classified as severe TBI,those with score of 9 to 12 are classified as moderate TBI and those with score 13 to 15 are classified as mild TBI[13,14]. There is association between severity of the TBI and ICP. The severe the TBI the higher the ICP hence the worst prognosis. It is important to measure ICP inorder to predict outcome of the TBI.

The optic nerve is an evagination of the brain; its course can be subdivided into an intraocular, an intraorbital, a canalicular and an intracranial segment.

The mild tortuous intraorbital optic nerve about 4 to 4.5cm long, it runs posterior medial to the orbital apex where it enters the optic canal 5mm long and 3 to 4mm wide. The entire intraorbitalcanalicular optic nerve is surrounded by arachnoid and dura sheaths which enclose a subarachnoid space (ONS). The pia mater that envelope the optic nerve covers the retina vessels as well. In intracranial hypertension the greatest degree of widening is usually seen in intraocular segment. A gradient of CSF pressure has been demonstrated in the perioptic compartment between optic canal and the anterior segment, regardless of the site of measurement along the optic nerve, there is linear relationship between the perioptic CSF pressure and the ICP[8].

The normal measurements of the ONS-complex is between 3.2mm and 5.6mm with a mean of 4.4mm with a difference range of 0.7mm between left and right [15,16].

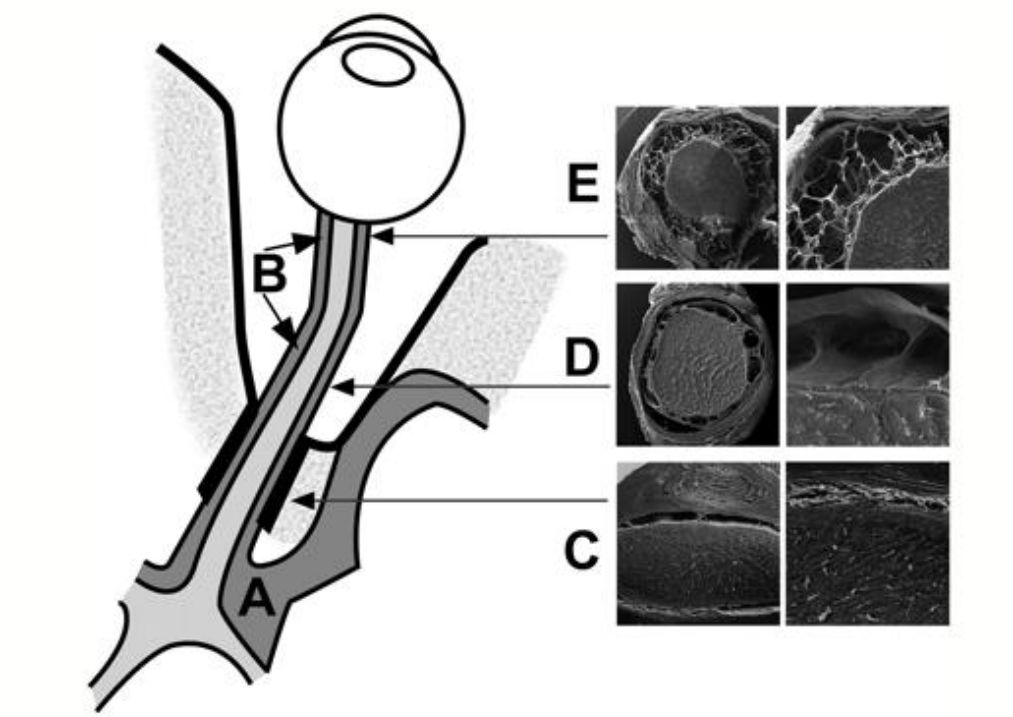


Figure 1: Schematic representation of the Cerebral Spinal Fluid; spaces surrounding the optic chiasm (intracranial CSF space – A) and the CSF surrounding the optic nerve (orbital CSF space –B) CSF flow from intracranial – A into the Subarachnoid space of the optic nerve – B.

The subarachnoid space of the optic nerve is the narrowest in the canalicular region – C.The intraorbital segment of the SAS is characterized by broad septae – D,where the retrobulbar segment is characterized by small trabeculae –E. Due to the CSF volume gradient the direction of flow is directed from the intracranial to the orbital SAS[17].

Several studies have shown that there is a strong relationship between Optic Nerve Sheath Diameter as done by CT scan and ICP[4,5,6,18,30].The higher the ONSD the higher the ICP the critical the TBI.ONSD measurements in CT scan is easy due to its good ability to reproduce as compared to other non invasive tools.So ONSD can be used as a tool to measure ICP, which will help in initial management of TBI patients in limited settings.In this study the utility of ONSD in patients with traumatic brain injury was determined using the initial brainCT scan.

1.2 Literature Review

Prevalence of Traumatic Brain Injury

TBI is the common cause of hospital admission following trauma and it is associated with significant long term morbidity and mortality. CT remains essential for detecting lesions that require immediate neurosurgical intervention, hospital observation and medical management[19].

Prevalence of TBI in USAgeneral adult population a Meta analysis found that prevalence in general population is 12% to 16.7% in males and 8.5% in females. Males have two times chances of having TBI than females;this suggests that being a male is a risk factor for TBI. In general population prevalence of TBI is 12%[20].

The common age group is below 40 and male patients are involved in a ratio of 4.3:1 when compared to female patients[21]. Also similar findings were observed by Gupta P.K et al[22].

Assessment of Severity of injury in Traumatic Brain Injury

In TBI, whenever there is decline in GCS or neurologic status has inversely relationship with severity of CT abnormality (hematoma, contusion, edema, or compressed basal cisterns)[8]. The Brain Trauma Foundation guidelines recommend insertion for a Glasgow Coma Scale of 8 or less with brain CT scan abnormalitiesor a normal CT finding with two or more risk factors (older than 40 years old, motor posturing or systolic blood pressure less than 90mmHg[23].

Table 1: Glasgow Coma Scale:

Glasgow Coma Scale	
Eye Opening	
Spontaneous	4
To loud voice	3
To pain	2
None	1
Verbal Response	
Oriented	5
Confused, Disoriented	4
Inappropriate words	3
Incomprehensible words	2
None	1
Motor Response	
Obeys commands	6
Localizes pain	5
Withdraws from pain	4
Abnormal flexion posturing	3
Extensor posturing	2
None	1

Brain CT scan findings in Traumatic Brain Injury patients

In TBI different CT patterns have been described. The common pattern isintracerebral hemorrhage followed by skull fractures, subdural hemorrhage, cerebral edema, mass effect [21]. In contrary to a study done byGupta P.K et al involving TBI patients reported that skull fracture was the commonest pathology followed by intracerebral hematoma, epidural hematoma, subdural hematoma, subarachnoid hematoma, diffuse axonal injury,brain swelling and edema, midline shift, pneumocranium and intraventricular hemorrhage [22].

A study done by Akinwunmi O.A et al observed that more than 65% had abnormal CT findings[24] with cerebral contusion followed by skull fractures being the most common patterns**.**

CT Optic Nerve Sheath Diameter findings

ONSD has shown to be useful in early detection of raised ICP [7, 25]. Different studies showed different results. It has a sensitivity and specificity of 92.9% and 97.6% respectively when ONSD value of >0.48cm is used, when cutoff point of>0.5cm is used sensitivity decreases to 85.7% and specificity increases to 100%[28]. Another study reported that it has sensitivity and specificity of 97% and 42% when cutoff point of >0.6 is used[25]. When the ONSD cutoff point of > 0.73 is used the sensitivity and specificity reduces to 86.4% and 74.6% respectively [4]however it associate with ICU mortality. This shows the importance of using a lower cutoff to get higher sensitivity and specificity.

In severe TBI patientsboth ONSD and CT features like basal cisternal effacement and diffuse sulcal effacement can be used to predict outcome[4]. However ONSD is much more predictive of ICP than other CT scan features [25.] 1mm increase in ONSD was related to hospital mortality two times[6.]

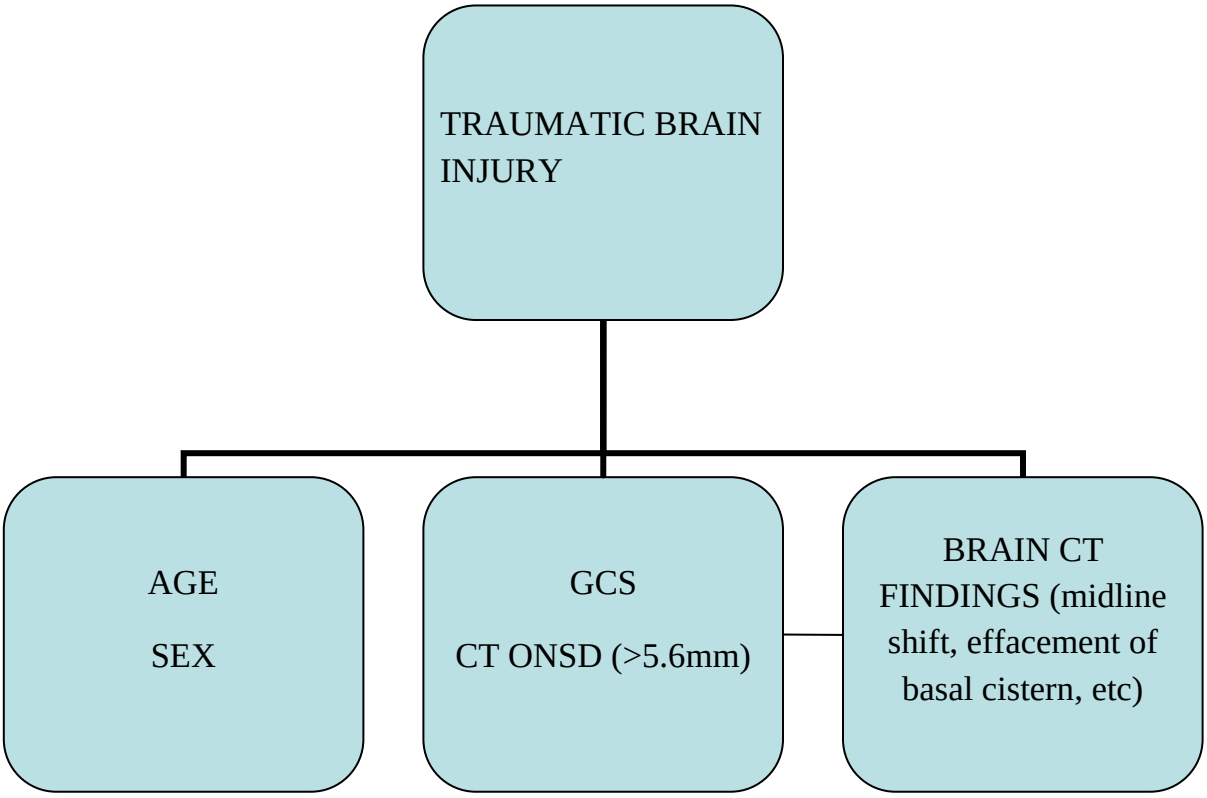
Summary of the findings done by previous CT study[4]and other ocular ultrasound for assessment of ICP concludes that further studies to be done in order to confirm the reliability of ONSD measurements after arranging the optic nerve in proper plane and several axis[26].

1.3 Problem Statement

Traumatic brain injury is a worldwide problem as known to cause serious morbidity and mortality. In UK 1.4 million people suffer head injury every year with 3500 people admitted in ICU and the overall mortality is severe TBI being 23%[27]. In Tanzania Muhimbili National Hospital respectively in six months survey from medical records May 2010 to October 2010; 5009 patients attended MOI emergence department. 2248(45%) were admitted and1138(23%) were diagnosed to have TBI irrespective of the GCS[23].

Optimum treatment for TBI is gauged upon maintenance of normal ICP to ensure normal brain physiologyand enhance recovery of the brain pathology. An established invasive method of ICP measurements requires skills and resources which are not within reach of many hospitals in Tanzania. The need to establish non invasive means of ICP measurement using available recourses like CT ONSD is a good one.

1.4 Conceptual Frame Work



1.5 Rationale

CT scanning remains essential for detecting lesions that require immediate neurosurgical intervention, though not reliably used in measuring ICP[5]. By using ONSD will help to measure if there is rise in ICP as shown previously in different studies that ONSD has strong association with ICP. CT ONSD is a promising tool for non invasive measurement of ICP since is free from short coming depicted from other non invasive tools like cerebral blood flow or cranial Doppler. This study will help the neurosurgeons and clinicians in early identification of patients with raised ICP. Using ONSD and GCS will help in assessing the severity of TBI.

1.6 Research Questions

1. Is thereanyrelationship between CT scan Optic Nerve Sheath Diameter and Glasgow Coma Scale in patients with traumatic brain injury referred to Muhimbili National Hospital?
2. Is there any relationship between CT scan Optic Nerve Sheath Diameter and CT intracranial lesions in patients presenting with TBI referred to CT unit at Muhimbili National Hospital?
3. What is the CT Optic Nerve Sheath Diameter findings in relation to age and sex in patients presenting with Traumatic Brain Injury referred to CT unit at Muhimbili National Hospital?

1.6 Objectives

1.6.1 Broad objectives

To determine the utility of CT scan Optic Nerve sheath diameter measurements in patients with traumatic brain injury referred to CT Unit at Muhimbili National Hospital from June to December 2016.

1.6.2 Specific objectives

1. To determine the proportion of patients with abnormal CT – ONSD findingsin relation to age and sex among patients presenting with TBI referred to CT unit at Muhimbili National Hospital from June 2016 to December 2016.

2. To determine the relationship between CT scan ONSD with CT scan intracranial lesions patients presenting with TBI referred to CT unit at Muhimbili National Hospital from June 2016 to December 2016.

3. To determine relationship between GCS and ONSD in patients presenting with TBI referred to CT unit at Muhimbili National Hospital from June 2016 to December 2016.

CHAPTER TWO

2.0 METHODOLOGY

2.1 Type of study

The study washospital based prospective cross sectional study.

2.2 Study duration

The study was conducted from June 2016 to December 2016.

2.3 Study area

The study was conducted at CT scan unit in Radiology department of Muhimbili National Hospital. MNH is the largest government hospital in Tanzania and it receives referrals from all over the country. MNH is the highest referral health facility in Tanzania and it is the largest and oldest teaching hospital in the country. Other imaging modalities available in the department are MRI, Ultrasound, Fluoroscopy, Mammographic and general X-ray. It has well motivated trained and qualified staff including radiologists, radiographers and nurses. Glasgow coma scale assessment was done at emergency department.

2.4 Study population

The study included all patients with TBI referred to CT scan unit Radiology department, Muhimbili National Hospital for brain studies from October 2016 to December 2016.

2.5 Inclusion criteria

All adult Patients aged 18 years and above presented with TBI and referred to CT scan unit at Muhimbili National Hospital from June 2016 to December 2016.

2.6 Exclusion criteria

The following were excluded from the study:

Patients with obvious facial or ocular trauma were 7

Patients less than 18 yrs were 21

Pre-existing ocular disease affecting the optic nerve and/or orbital cavity were 2

2.7 Patients involved

All patients aged 18 years and above with TBI whofulfilled inclusion criteria and their relatives have signed the consent form.

2.8 Sampling method

Consented patients were consecutively included in the study until the sample size was reached.

2.9 Sample size

The sample size calculated from Fisher's formula;

$n=Z^2P\ (1-P)/E^2$

Where: n= sample size,

Z = (1.96)

P = prevalence estimated for patients presenting with TBI at MOI or CT unit at MNH

95% confidence interval wasused.

E = margin error 5%

We weresampling an extra 5% to account for possible non-response

The study done by Schock at MOI on CT scan findings in patients with mild head injury, he calculated its sample size assuming that the prevalence of normal CT scans findings to be 13.8%[23].Hence this study made the same assumption in calculating the required minimum sample size to answer the research questions.

N=182.8

Then assuming a 5% non-response rate, the final minimum required sample size was190 however 212 traumatic brain injury patients were recruited in the study. Therefore this study interviewed 190 patients presented with head injury at MNH over the period of six months from October 2016 to December 2016.

2.10Collection of data

Data collection was done through structured questionnaire whichwas filled by the Investigator and Image evaluator upon reaching consensus. Data collected was included socio-demographics, GCS on admission and CT scan Brain findings includes midline shift of >5mm,effacement of basal cistern, intraventricular hemorrhage, subdural hematoma and ONSD was measured 3mm from the sclera of the eye globe.

2.11 Imaging and Evaluation

Patients in the study underwent standard CT scan of the head in the Radiology Department of MNH. The images were obtained with the patient lying comfortably in the supine position on the CT couch with no movement in order to ensure that the planned scan region matches the region actually scanned and that the entire brain and calvarium is imaged.

2.11.1 Scan protocol and parameters

The datasets were acquired using 128 slice dual Source CT MDCT Scanner (Siemens, SOMATOM Definition Flash, Forchheim, Germany) with 300 ms gantry rotation time.

(1) A noncontrast scan was performed (5mm slice, tube current up to 34 mA at 120kV).
(2) The obtained axial images were reconstructed using different reconstruction techniques on a workstation.

2.11.2Optic nerve measurement

CT scanning was performed by using 128 slice dual energy Siemens MDCT(Siemens, SOMATOM Definition Flash, Forchheim German) before surgery. The images were taken in axial plane and the ONSD measurements were taken in the same plane. ONSD was measured in initial imaging following trauma at a distance 3mm behind the globe, immediately below

the sclera. It was measured from one side of the optic nerve sheath to the other through the centre of the optic nerve sheath to the other. The diameters measured for the patient's left and right eyes were obtained to get the mean value. The cutoff ONSD value of >0.57cm was considered abnormal in this study.

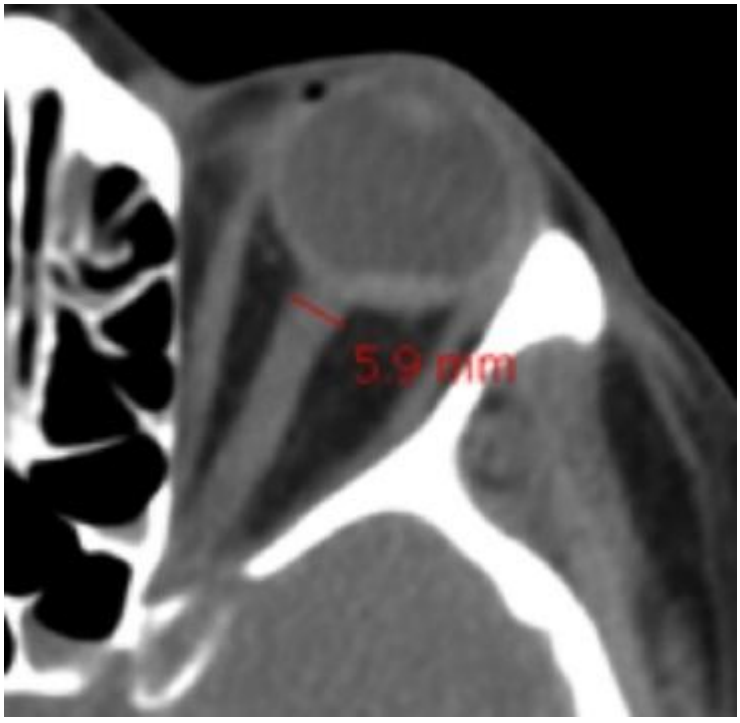


Figure 2: Example on how to measure the ONSD on CT scans[4].

2.12 Data analysis

Data analysis was done using the Statistical Package for Social Sciences (SPSS) version 20. Statistical Association between ages, GCS, CT ONSD and other brain findings was done using cross tabulations and Chi-square test was used to compare proportions. P value of < 0.05 was considered statistically significant.

2.13 Ethical clearance

The proposal was presented to the department of Radiology, Muhimbili University of Health and Allied Sciences. Thereafter Ethical clearance was obtained from the MUHAS Senate Research and Publication Committee and informed consent was obtained from the study population before being included in the study. The patient's data was de coded to ensure confidentiality. Furthermore the data base was kept in a secured place.

Permission to conduct the study was obtained from MNH and all participants who were found to have Traumatic Brain Injury received proper management. Depending on clinical presentation, GCS and CT scan findings patients with mild and some with moderate TBI were managed consecutively while some with moderate and severe TBI were intervened surgically.

2.14 Dissemination plan

The final study report was submitted to the Muhimbili University of Health and Allied science as part of fulfillment for the award of the Master of Medicine (Radiology) degree. Therefore it was firstly presented to Muhimbili University of Health and Allied Sciences, also the findings were reported to MNH authorities as well as MOI since all head injury patients are referred to MOI for management. Lastly, the findings of this study will be presented in conferencesand also will be published in local and international medical journals with the assistance from the supervisor.

CHAPTER THREE

3.0 RESULTS

Table 2: The percentage distribution of CT ONSD findings by age and sex in patients presented with Traumatic Brain Injury referred to Muhimbili National Hospital. N=212

	ONSD status			P value
Characteristics	**Normal**	**Abnormal**	**Total**	
Number of Patients	129(60.8%)	83(39.2%)	212(100%)	Nil
Gender Male	103(58.9%)	72(41.1%)	175(100%)	0.196
Female	26(70.3%)	11(29.7%)	37(100%)	
Mean age (years)	32 (18-74)	30(18-76)		0.2071
Mean ONSD	0.5(0-0.56)	0.6(0.28-0.83)		0.0001
Mean GCS	13.8(3-15)	11.7(3-15)		0.0011

The number of participants in this study was 212 patients. Patients with abnormal CT ONSD were 39.2%. Male (41.1%) had abnormal ONSD than female (29.7%). The participants mean age was 33.26 years old with range of 18-76 years old. The mean normal ONSD was 0.5cm and mean abnormal ONSD was 0.6cm with the P value of 0.0001 and mean GCS was 14 for normal ONSD and 12 for abnormal ONSD with the P value of 0.0011 both were statistically significant as show in the table 2 above. This means that male patients with younger age and low GCS are related to abnormal ONSD.

Table 3: The percentage distribution of CT ONSD findings by age in patients presented with Traumatic Brain Injury referred to Muhimbili National Hospital. N=212

		ONSD results			P value (Pearson's X^2) at 95%CI
		Normal (%)	Abnormal (%)	Total (%)	
Age	Below 44	112 (61.2)	71 (38.8)	183 (100)	0.791
	45 and above	17 (58.6)	12 (41.4)	29 (100)	
	Total	129 (60.8)	83 (39.2)	212 (100)	

Patients aged below 44 years had more abnormal CT ONSD than patients aged above 45 year with the Pvalue of 0.791 which was not statistically significant as described in table 3 above.

Table 4: The relationship between age group and Glasgow coma scale in the patients presented with Traumatic Brain Injury referred to Muhimbili National Hospital. N=212

		GCS				P value (Pearson's X^2) at 95% CI
		Severe brain injury (%)	Moderate brain injury (%)	Mild brain injury (%)	Total (%)	
Age group	18-24	6 (12.0)	9 (18.0)	35 (70.0)	50 (100)	0.933
	25-34	11 (13.3)	11 (13.3)	61 (73.5)	83 (100)	
	35-44	4 (8.0)	9 (18.0)	37 (74.0)	50 (100)	
	45-54	2 (12.5)	4 (25.0)	10 (62.5)	16 (100)	
	55-64	0 (0.0)	2 (22.2)	7 (77.8)	9 (100)	
	65+	0 (0.0)	1 (25.0)	3 (75.0)	4 (100)	

The Glasgow coma scale shown that mild injuries were higher in the young age from 18 to 44, in which the highest affected age group 61 (28.8%) was from 24 to 34 as shown in the table 4 above.

The CT Brain findings in patients presenting with TBI referred to CT unit at Muhimbili National Hospital from June to December 2016.

Table 5: The traumatic brain injuries with fracture types in the patients presented with Traumatic Brain Injury referred to Muhimbili National Hospital. N=212.

Type of fracture		ONSD results			P value (Pearson's X^2) at 95%CI
		Normal	Abnormal	Total	
Linear/Non displaced	Yes	30 (40%)	49 (60%)	79 (100%)	0.0001
	No	99 (74.4%)	34 (25.6%)	133 (100%)	
	Total	129 (60.8%)	83 (39.2%)	212 (100.0%)	
Depressed	Yes	30 (40%)	49 (60%)	79 (100%)	0.0001
	No	99 (74.4%)	34 (25.6%)	133 (100%)	
	Total	129 (60.8%)	83 (39.2%)	212 (100.0%)	
Scull basal fracture	Yes	14 (52%)	13 (48%)	27 (100%)	0.305
	No	115 (62%)	70 (38.0%)	185 (100%)	
	Total	129 (60.8%)	83 (39.2%)	212 (100.0%)	
Sutural diastasis	Yes	10 (4.7%)	6 (2.8%)	16 (7.5%)	0.888
	No	119 (56.1%)	77 (36.3%)	196 (92.5%)	
	Total	129 (60.8%)	83 (39.2%)	212 (100.0%)	

The table 5 above shows that 60% of patients with linear and depressed fractures were significantly contributed to abnormal ONSD and traumatic brain injuries [P=0.0001 each].

Table 6: The Extra-axial lesions in patients presented with Traumatic Brain Injury referred to Muhimbili National Hospital. N=212

	Extra-axial type	N	Mean	Std. Deviation	Std. Error Mean	T	Df	P value
ONSD	Epidural haematoma	29	0.5166	0.19023	0.03532	-1.224	56	0.224
	Subdural haematoma	29	0.5693	0.13289	0.02468			

The table 6above found that Epidural haematoma with a mean ONSD of (0.52 ± 0.035)cmand subdural hematoma (0.57 ± 0.025)cm had no significant association with ONSD, t(56) = -1.224, p=0.224.

Table 7: The intra-axial lesions with ONSD results in the patients presented with Traumatic Brain Injury referred to Muhimbili National Hospital. N=212

	Intra-axial type	N	Mean	Std. Deviation	Std. Error Mean	T	Df	P value
ONSD	Diffuse axonal injury	3	0.5617	0.14268	0.08238	0.442	71	0.954
	Cortical contusion	70	0.5207	0.1577	0.01885			

Diffuse axonal injurywith a mean CT ONSD of (0.56 ± 0.082)cm andcortical contusion (0.52 ± 0.019)cmhad no significant association with ONSD, t (71) = 0.442, p = 0.954 as shown in the table 7 above.

Table 8: The distribution of CT ONSD findings by complication of head injuries in the patients presented with Traumatic Brain Injury referred to Muhimbili National Hospital. N=212

CT findings		N	Mean	ONSD Mean	Std. Deviation	SE Mean	T	Df	P value
Cerebral oedema	Yes	47	0.5941	0.62	0.06036	0.00881	5.27	210	**0.0001**
	No	165	0.4551		0.17772	0.01384			
Midline shift	Yes	22	0.6102	0.62	0.06946	0.01481	3.75	210	**0.0001**
	No	190	0.4716		0.17173	0.01246			
Effacement of cistern	Yes	80	0.5733	0.62	0.11116	0.01243	6.37	210	**0.0001**
	No	132	0.433		0.17689	0.0154			
Effacement of ventricles	Yes	50	0.5781	0.62	0.10235	0.01448	4.61	210	**0.001**
	No	162	0.4575		0.17597	0.01383			

The mean CT ONSD among patients with cerebral edema, midline shift, effacement of cistern, and ventricles were higher as compared to patients without these abnormalities and these observations were statistically significant, $p< 0.001$ as shown in the table 8 above.

Table 9: The percentage distribution of CT ONSD findings by GCS among patients presenting with TBI referred to CT unit at Muhimbili National Hospital from June to December 2016. N=212

		ONSD results			P value
		Normal (%)	Abnormal (%)	Total (%)	(Pearson's X^2) at 95% CI
GCS	Severe brain injury	9 (39.1)	14 (60.9)	23 (100)	**0.0001**
	Moderate brain injury	12 (33.3)	24 (66.7)	36 (100)	
	Minor brain injury	108 (70.6)	45 (29.4)	153 (100)	

There was strong association [P=0.0001] between GCS among patients with TBI and ONSD. These were the findings: 61% of patients with severe TBI had abnormal ONSD, 67% of patients with moderate TBI had abnormal ONSD and in patients with mild TBI 24% of them had abnormal ONSD as shown in the table 9 above.

CHAPTER FOUR

4.0 DISCUSSION

Two hundred and twelve Traumatic Brain Injury patientswere enrolled to this hospital based cross sectional study. 82.5% of patients were male and 17.5% of patients were female. There was male predominance with male to female ratio of 4.7:1. This ratio is highercompared to the study done by Frost R. B.et alwhere ratio is 2:1[20].

Similar findings were observed from the studiesprevious studywith male to female ratio of 4.3:1and 4:1 respectively [21, 22]. This is because male are involved more in activities that helps to take care of the families and driving cars and riding motorcycles is usually done by male.

The participants mean age was 33.26 years with range of 18-76 years and standard deviation of 11.7. The highest age group was 25-34years. This findings is nearly similar to a study done by on Outcome of mild TBI patients where the mean age was 33.6years and the mostly involved age group was between 25-34years same as in this study[23]. This is because teenagers and young adult are the productive age groups.

This study shows that 82% of patients had abnormal CT scan findings comparable to findings done by Akinwunmi O.A et al 65.5%[24]. This is due to capacity of the hospital being a referral national hospital with radiological, Orthopaedic and neurosurgical care.

Skull fractures were the most common presentation followed by effacement of cistern and cortical contusion. Similar findings were observed by Gupta P.K where skull fractures were the common lesions[24].Comparable to previous studies [21,24] where by cortical contusion/intracerebral hemorrhage followed by skull fractures were the common findings.

Several studies shown that there is relationship between CT scan ONSD and raised ICP in patients with TBI[4,5,6,7,30].

In the current study patients with abnormal ONSD were 39.2% of the study population. The selected ONSD cutoff points in previous studies were >0.57cm [16, 29], >0.58cm[30], >0.6cm [6, 25],

>0.62cm [7], 0.73cm [4]. The obtained mean ONSD of 0.6cm was higher compared to the previous studies done on normal measurements of ONSD with mean of 4.1 and 4.4cm[15, 16]. This is due to presence of different intracranial pathologies obtained following TBI.ONSD of greater than 0.5cm have 96% probability of having raised ICP and ONSD value of >0.58cm as a cutoff value for ICP >20mmHg and has probability of 90% to correct diagnosis[30].

More than half of patients with linear and depressed fractureshad abnormal ONSD which were statistically significantly contributed to the traumatic brain injuries [P=0.0001 each].This shows that if patient's presents with depressed and linear fractures there are 60% chances of having abnormal ONSD which signifies increased ICP though some of these patients had mixed intracranial pathologies.Little is known on relationship between types of fractures and ONSD measurements.

This study found that Epidural hematoma, subdural hematoma, diffuse axonal injury and cortical contusion had not statistically significant in relationship to ONSD. Similar findings were observedin a study done by Kiran S.D et al [30.]

This study found that whenever there was an increased ONSD these parameters were high in TBI patients with raised ICP. Patients with cerebraloedema, effacement of cistern, midline shift and effacement of ventricles had abnormal ONSD with P value< 0.001 which were statistically significant. Similar findings were reported by previous study where by strong relationship between CT signs suggestive of elevated ICP in severe TBI patients and ONSD [4].Mild and moderate TBI patients were excluded in his study.

However these CT findings in isolation did not show any statistical significance [30].ONSD was a strong predictor of raised ICP than other CT scan features and can be used in triaging TBI patients as non invasive tool with a cutoff point of 0.6cm[6].

Findings shows that there was strong relationship [P=0.0001] between GCS and ONSD in patients with TBI.In cases with severe TBI there are 61% chances of having abnormal ONSD, 67% in moderate TBI cases and 29% in mild TBI cases as it has been described in this study. All these findings were statistically significant showing that there is closely relationship

between the two. As severity of TBI increased then the ICP increased as described in pathophysiology above hence increase in ONSD as it has shown above. Similar findings were observed were observed in the previous studies [4,30].However when ONSD is >0.73cm hospital mortality increases [4]. These findings can be used in a setting where there are no standard measurements of intraventricular catheters as a way of triaging patients with signs of increased ICP after doing initial CT scan.

From this study CT scan ONSD is recommended in patients with moderate and severe TBI than mild TBI.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMENDATION

5.1. Conclusion

Optic Nerve Sheath Diameter has shown by this study to be useful in Traumatic Brain Injury patients as there is relationship between GCS and ONSD in TBI patients. Patients with moderate and severe TBI have higher ONSD measurements than mild TBI patients. In a limited setting CT ONSD obtained from initial scan can be used in triaging patients at risk of having raised ICP. ONSD measurement is indicated in patients with moderate and severe TBI than mild TBI. Routine CT scan can be advocated in TBI managing assessment of ICP.

5.2 Recommandation

A big study population involving multicenter should be conducted to obtain normal CT ONSD of the general population.Patient with moderate and serere head injury should have their CT ONSD measured on initial CT scan for early detection of raised ICP.Follow up by imaging is recomended in traumatic brain injury patients.

5.3Study limitation and mitigation.

It was a hospital based study hence findings may not be generalizable to general community. Some of the patients were not able to do CT scan due to financial constrain, some were unstable patients and some died following severe injury so were excluded in the study.

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APPENDICES

Appendix I: Questionnaire

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

SCHOOL OF MEDICINE - DEPARTMENT OF RADIOLOGY

P.O.BOX 65001 MUHIMBILI

DAR ES SALAAM

TANZANIA

NO.	QUESTION AND EXPLANATIONS	RESPONSE		
Q1	Serial No.:			
Q2	Date			
Q3	Gender	1.Male 2.Female		
Q4	Age			
Q5	History of Head injury	1.Yes 2.no		
Q6	Duration of the head injury in hrs:			
Q7	Injury cause	1.Fall 2.RTA 3.Violence 4. others		
Q8	Presenting symptoms	1.Headache 2.Hemiperesis per E.N.T 3.Confusion 4. loss of consciousness 6. others		
Q9	Level of Counciousness (GCS)			

CT SCAN FINDIINGS FORM

Q11	Presence of fractured bone	1.Yes 2.No		
Q12	Type of fracture	1.linear/non displaced 2. depressed 3. Skull basal fracture 4. Suturaldiastesis	Yes/no	
Q13	Presence of extra axial lesion	1.yes 2. no		
Q14	Types of extra axial lesions	1.epidural heamatoma 2.Subdural haematoma 3.subarachnoid hemorrhage 4. subdural hygrom	Yes/no	
Q15	Presence of intra axial lesion	1.yes 2.no		
Q16	Types of intra-axial lesions	1.diffuse axonal injury 2.cortical contusion 3.intraparenchymal haemorrhage 4.intraventricular haemorrhage 5.brain stem lesion	Yes/no	
Q17	Complication of head injury	1.Yes 2.No		
Q18	Types of complication	1.cerebral edema 2.midline shift 3.effacement of cistern 4.effacement of ventricles	Yes/no	
Q19	ONSD	1.right 2.left 3averege		

Appendix II: Consent Form(English Version)

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

DIRECTORATE OF RESEARCH AND PUBLICATIONS, MUHAS

ID-NO……

Consent to Participate in a Study

My name is Dr. Veronica H. Lyandala; I am conducting study on association between CT scan ONSD and GCS in patients with TBI in Radiology department at MNH.

Study Purpose

The study is conducted as partial fulfillment of the requirements of MMed Radiology at MUHAS. The study is also conducted to establish reference parameters which can be used for diagnosis and follow up of patients in our department.

How to be involved

The patients or relatives who agree to participate in this study will be required to sign the consent form, then interviewed after that.

Confidentiality

The information obtained from you will be confidential. No name will appear on any document of this study instead Identification numbers will be used.

Participation and right to Withdraw

Involvementin this study is voluntary. You can participate or refuse to participate from this study. Refusal to participate from this study will not interfere with your management.

Benefits

The information that you provide will help us to correlate the radiographic findings among patients with. Thus the studies outcomes will help to improve patients' management thus improve quality of life.

Contact Personally

If you ever have questions about this study, you should contact the Principal Investigator, Dr. Veronica H. Lyandala, Muhimbili University of Health and Allied Sciences, P. O. Box 65001, Dar es Salaam. Tel. 0717 770790**.**

OR in case you have questions about your rights of participation in this study you may contact;

Prof M. Aboud Chairperson of the Senate Research and Publications Committee,

P. O. Box 65001 DSM. Telephone**:** +255 022 2152489

Dr. Lulu Fundikira who is the supervisor of this study

Tel. +255 715 994849

Participant agrees ……..

I ……. have read the contents in this form. My questions have been answered. I am willing to participate in this study.

Signature of participant ……Date…….……

Signature of Researcher ……..Date…….

Appendix III: Consent Form (Swahili Version)

CHUO KIKUU CHA SAYANSI ZA AFYA MUHIMBILI

KURUGENZI YA TAFITI NA UCHAPISHAJI

FOMU YA RIDHAA

Namba ya utambulisho ---

Ridhaa ya kushiriki kwenye utafiti

Jina langu ni Dr. Veronica H. Lyandala nafanya utafiti wenye lengo la kuangalia uhusiano kati ya ONSD pamoja na GCS kwa wagonjwa waliopata TBI/walioumia vichwa au ubongo na kufanyiwa CT scan ya kichwa kwenye idara ya vipimo vya mionzi katikaHopitali yaTaifa Muhimbili.

Madhumuni yaUtafiti huu ni pamoja na kutimiza sehemu ya matakwa ya shahada ya uzamili ya matibabu kitengo cha vipimo vya mionzi Chuo Kikuu cha Afya na Sayansi yaTiba Muhimbili. Hali kadhali kakupata vipimo ambavyo vinaweza kutumika kusaidia kwenye matibabu ya wagonjwa waliopata TBI(walioumia vichwa au ubongo).

Jinsi ya kushiriki

Ukikubali kushiriki katika utafiti huu, utasailiwa alafu utatakiwa kujibu maswali kutoka kwenye dodoso lililoandaliwa alafu mgonjwa ataendelea na kipimo kama kawaida.

Usiri

Taarifa zote zitakazo kusanywa kupitia dodoso hili zitakuwa ni siri. Jina lako halitatumika badala yake tutatumia namba ya utambulisho.

Uhuru wa kushiriki na haki ya kujitoa

Kushiriki kwenye utafiti huu ni hiari. Unaweza kushiriki au kukataa kushiriki na hii haitakuondolea haki ya kupata matibabu yako.

Nani wa kuwasiliana naye

Kama unamaswali kuhusiana na utafiti huu, wasiliana na wafuatao;

Mtafiti mkuu, Dr. Veronica H. Lyandala, Chuo Kikuu cha Afya na Sayansi yaTiba Muhimbili, S. L. P. 65001, Dar es Salaam. Simu0717 770 790.

Au waweza kuwasiliana na **Prof M. Aboud,** Mwenyekiti wa kamati yaUtafiti naUchapishaji,

S.L.P 65001,Dar es Salaam.Simu+255 022 2152489

Pia waweza kuwasiliana na msimamizi wa utafiti huu Dr. Lulu Fundikira,

Chuo Kikuu cha Afya na Sayansi ya Tiba Muhimbili,

S.L.P 65001, Dar se salaam. Simu 0715 994849

Kama umekubali kushiriki weka sahihi

Mshiriki ni mekubali …….....

Mimi..... nimesoma maelezo ya fomu hii nimeyaelewa na nimekubali kushiriki katika utafiti huu.

Sahihi ya mshiriki……

Tarehe ya kutia sahihi…….....

Sahihi ya mtafiti……