



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكرو فيلم

بسم الله الرحمن الرحيم



MONA MAGHRABY



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم



شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلم



MONA MAGHRABY



شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



MONA MAGHRABY



Monitoring osmotherapy in traumatic brain injury patients: correlation between ultrasound assessment of optic nerve sheath diameter and computed tomography scan

Thesis

*Submitted for Partial Fulfillment of Master Degree
in Intensive Care*

By

Hossam Mohammed Mohammed Elmorshedy

M.B.B.CH

Under supervision of

Prof. Dr. Galal Adel Alkady

*Professor of Anesthesiology, Intensive Care and Pain Management
Faculty of Medicine, Ain Shams University*

Dr. Salwa Omar Elkhatab Amin

*Assistant Professor of Anesthesiology, Intensive Care and Pain Management
Faculty of Medicine, Ain Shams University*

Dr. Waleed Abdallah Ibrahim

*Assistant Professor of Anesthesiology, Intensive Care and Pain Management
Faculty of Medicine, Ain Shams University*

*Faculty of Medicine
Ain Shams University*

2021

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قَالَ

سَبَّحَانَكَ لَا إِلَهَ إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ
الْعَلِيمُ الْعَظِيمُ

صدق الله العظيم

سورة البقرة الآية: ٣٢

Acknowledgment

*First and foremost, I feel always indebted to **ALLAH**,
the Most Kind and Most Merciful.*

*I'd like to express my respectful thanks and profound gratitude to **Prof. Dr. Galal Adel Alkady**, Professor of Anesthesiology, Intensive Care and Pain Management, Faculty of Medicine, Ain Shams University for his keen guidance, kind supervision, valuable advice and continuous encouragement, which made possible the completion of this work.*

*I am also delighted to express my deepest gratitude and thanks to **Dr. Salwa Omar Elkhattab Amin**, Assistant Professor of Anesthesiology, Intensive Care and Pain Management, Faculty of Medicine, Ain Shams University, for her kind care, continuous supervision, valuable instructions, constant help and great assistance throughout this work.*

*I am deeply thankful to **Dr. Waleed Abdallah Ibrahim**, Assistant Professor of Anesthesiology, Intensive Care and Pain Management, Faculty of Medicine, Ain Shams University, for his great help, active participation and guidance.*

Hossam Mohammed

List of Contents

Title	Page No.
List of Abbreviations.....	i
List of Tables	iii
List of Figures	iv
Introduction	1
Aim of the Work.....	3
Review of Literature	
Traumatic Brain Injury	4
Brain Edema and ICP	14
Monitoring of Intracranial Pressure	29
Optic Nerve Sheath Diameter & Ocular Ultrasound	37
Osmotic Therapy in Traumatic Brain Injury	47
Subjects and Methods.....	52
Results	58
Discussion	71
Conclusion	80
Limitation.....	81
Summary	82
References	87
Arabic Summary	—

List of Abbreviations

Abb.	Full term
ABG	Arterial blood gases
AMPA	α -amino-3-hydroxy-5-methyl-4-isoxazolepropionic acid
AMS	Acute Mountain sickness
ASDH.....	Acute subdural hematoma
AUC	Area under curve
AV fistula	Arteriovenous fistula
BBB	Blood-brain barrier
CBC	Complete blood count
CBF.....	Cerebral blood flow
CDC	Centers for Disease Control and Prevention
CNS	Central nervous system
CPP	Cerebral perfusion pressure
CSF	Cerebrospinal fluid
CT	Computed tomography
DAI	Diffuse axonal injury
DKA.....	Diabetic ketoacidosis
EDH.....	Epidural Hematoma
EVD	External ventricular drain
FLAIR	Fluid-attenuated inversion recovery
FV	Flow velocity
GCS.....	Glasgow Coma Scale
HACE	High-altitude cerebral edema
ICH	Intracerebral haemorrhage
ICP.....	Intracranial pressure
IOP.....	Intraocular pressure
MAP.....	Mean systemic arterial pressure
MRI.....	Magnetic resonance imaging

List of Abbreviations Cont...

Abb.	Full term
NMDA	N- Methyl D- Aspartate
ON	Optic nerve
ONSD	Optic nerve sheath diameter
RBS.....	Random blood glucose
RGC	Retinal ganglion cell
SAH	Subarachnoid haemorrhage
SS	Single Shot
TBI.....	Traumatic brain injury
TCD	Transcranial Doppler
TMD.....	Tympanic membrane displacement
US	Ultrasound
USG	Ultrasonography
VRIs	Ventriculostomy-related infections

List of Tables

Table No.	Title	Page No.
Table (1):	A Description for the Included Diagnostic Techniques.....	33
Table (2):	Demographic characteristics of 30 patients with increased ICP:	58
Table (3):	Follow up of vital data among studied patients with increased ICP along 3 successive days	59
Table (4):	Follow up of laboratory parameters among studied patients with increased ICP along 3 successive days	60
Table (5):	Follow up of right optic nerve sheath diameter before and after mannitol among studied patients with increased ICP along 3 successive days	62
Table (6):	Follow up of left optic nerve sheath diameter before and after mannitol among studied patients with increased ICP along 3 successive days	64
Table (7):	Follow up of brain edema among studied patients with increased ICP along 3 successive days	66
Table (8):	Relation between CT brain edema and right ONSD in third day before and after last dose	67
Table (9):	Relation between CT brain edema and left ONSD in third day before and after last dose	68

List of Figures

Fig. No.	Title	Page No.
Figure (1):	The inter-relationship between primary and secondary injury in TBI is shown. Secondary physiological insults can potentiate ischemia and lead to exacerbation of secondary injury	5
Figure (2):	A 19-year-old male patient with diffuse axonal injury and Glasgow Coma Scale score of 8 after a motorcycle accident	9
Figure (3):	Contributing events in the pathophysiology of Secondary Brain Injury	11
Figure (4):	Stages of cerebral edema	19
Figure (5):	Invasive methods of measuring ICP	30
Figure (6):	Image from Lundberg's 1960 publication on Continuous recording and control of ventricular fluid pressure in neurosurgical practice	31
Figure (7):	Optic nerve segments	38
Figure (8):	Longitudinal section of a normal human optic nerve showing the sheath in its different parts ..	40
Figure (9):	Ocular sonography of the optic nerve sheath	44
Figure (10):	A) show how to measure ONSD, B) show difference between normal and increasing ICP ...	54
Figure (11):	Follow up of right optic nerve sheath diameter before mannitol among studied patients with increased ICP along 3 successive days	63

List of Figures Cont...

Fig. No.	Title	Page No.
Figure (12):	Follow up of right optic nerve sheath diameter after mannitol among studied patients with increased ICP along 3 successive days	63
Figure (13):	Follow up of left optic nerve sheath diameter before mannitol among studied patients with increased ICP along 3 successive days	65
Figure (14):	Follow up of left optic nerve sheath diameter after mannitol among studied patients with increased ICP along 3 successive days	65
Figure (15):	Follow up of brain edema among studied patients with increased ICP along 3 successive days	66
Figure (16):	ROC curve of Right ONSD before and after mannitol therapy as a predictor of brain edema	69
Figure (17):	ROC curve of left ONSD before and after mannitol therapy as a predictor of brain edema	70

INTRODUCTION

Elevated intracranial pressure (ICP) and cerebral edema are common neurologic complications of various cerebral disorders, such as traumatic brain injury (TBI), intracerebral haemorrhage (ICH) & subarachnoid haemorrhage (SAH) (*Wang et al., 2020*).

Early detection, evaluation and treatment of elevated ICP improve outcome of TBI. Invasive ICP monitoring is the gold standard method for ICP monitoring, but invasive techniques are associated with risk of complications such as hemorrhage and infection, also, it is not available in all places and requires high expertise (*Raboel et al., 2012*).

Some non-invasive methods for measuring ICP can be used as alternatives to invasive techniques, including transcranial Doppler, optic nerve sheath diameter (ONSD), computed tomography (CT), magnetic resonance imaging (MRI), and fundoscopy (*Raboel et al., 2012*).

These non-invasive techniques do not carry the risk of complications as with invasive methods. Recently, adult studies have reported that measuring ONSD with non-invasive imaging technologies such as CT, MRI and ultrasound can be used as an alternative method to evaluate increased ICP (*Kimberly et al., 2008*).

However, CT and MRI for ONSD measurements are time consuming, costly and usually require patient transportation.

Thus, ultrasound assessments of ONSD could be a better option because reliable, accessible, easy to learn, low cost and rapid bedside operation without the need for radiation exposure, especially for cases that are unstable and require real-time monitoring of ICP in an intensive care unit (**Tayal et al., 2007**).

The optic nerve sheath is continuous with the meninges of the central nervous system and is encased with the subarachnoid membrane. Cerebrospinal fluid (CSF), located in the subarachnoid space, accumulates in the optic nerve sheath thereby widening its diameter in the setting of increased ICP and limited intracranial compliance (**Sekhon et al., 2014**).

Osmotherapy is one treatment intervention in the care of patients with severe head injury resulting in cerebral edema and intracranial hypertension. The effect of hyperosmolar solutions on brain tissue was first studied nearly 90 years ago. Since that time, mannitol has become the most widely used hyperosmolar solution to treat elevated intracranial pressure (**Knapp & James, 2005**).

AIM OF THE WORK

To compare ultrasound assessment of optic nerve sheath diameter as a monitoring tool of adequacy of brain dehydration by osmotherapy in traumatic brain injury in comparison to the current standard of using brain CT.