

Trauma – Induced Brain Changes In Cases of Closed Head Injuries

Thesis submitted in the partial fulfillment
of The M.D. Degree in Forensic Medicine

By

Noha Sadek El Sayed Ibrahim

M.Sc. forensic Medicine

Medicolegal Examiner-Ministry of Justice

Under supervision of

Prof. Dr. Magdi Mahmoud El- Meligui

Professor of Forensic Medicine & Clinical Toxicology

Faculty of Medicine – Ain Shams University

Prof. Dr. Hanaa Mohammed Abdel Rahman

Professor of Forensic Medicine & Clinical Toxicology

Faculty of Medicine – Ain Shams University

Dr. Rasha El-Hossiny Abou Anza

Lecturer of Forensic Medicine & Clinical Toxicology

Faculty of Medicine – Ain Shams University

Dr. Haidy Farid Abdel Hamid

Lecturer of Anatomy

Faculty of Medicine – Ain Shams University

Faculty of Medicine – Ain Shams University

List Of Charts

<i>Chart</i>	<i>Page</i>
. The number and percentage of cases in each age group of the studied cases.	131
. The number and percentage of each gender in the studied cases.	133
. The number and percentage of types of head trauma in the studied cases.	134
. The frequency of head injury in the studied cases.	135
. The number and percentage of causes of head injury in the studied cases.	136
. The circumstances of head injury in the studied cases.	137
. The number and percentage of external head injury in the studied cases.	138
. The survival time in the studied cases.	139
. The percentage of different types of intervention in the studied cases.	140
. The number and percentage of other external injuries in the studied cases.	141
. The number and percentage of other internal lesions in the studied cases.	143
. The number and percentage of associated diseases in the studied cases.	145
. The number and percentage of types of head trauma in relation to each age group of the studied cases.	147
. The number and percentage of frequency of head injury in relation to each age group of the studied cases.	150
. The number and percentage of causes of head injury in relation to each age group of the studied cases.	153
. The number and percentage of circumstances of head injury in relation to each age group of the studied cases.	156
. The number and percentage of external head injuries in relation to each age group of the studied cases.	159
. The number and percentage of types of head trauma in relation to each gender of the studied cases.	165
. The frequency of head injury in relation to each gender of the studied cases.	167

List Of Charts

<i>Chart</i>	<i>Page</i>
. <i>The number and percentage of causes of head injury in relation to each gender of the studied cases.</i>	169
. <i>The number and percentage of external head injuries in relation to each gender of the studied cases.</i>	171
. <i>The percentage of survival time in relation to each gender of the studied cases.</i>	173
. <i>The percentage of interventions in relation to the gender of the studied cases.</i>	175
. <i>The number and percentage of other external injuries in relation to each gender of the studied cases.</i>	177
. <i>The relation between interventions and survival time in the studied cases.</i>	179
. <i>The relation between survival time and other internal injuries in the studied cases.</i>	181

List of Contents

<i>Item</i>	<i>Page</i>
❖ Lists of Tables , Charts, Figures & Abbreviations and Glossary	a- j
❖ Introduction & Aim Of Work	
❖ Review of Literature	
◆ Anatomy of the Head	
◆ Histology of the Brain	
◆ Head Injury	
◆ Mechanism of Head injury	
◆ Pathology of Head Injury	
◆ Outcome of Head Injury	
❖ Methodology	
❖ Results	
◆ Photographs	
❖ Discussion	
❖ Summary and Conclusion	
❖ Recommendations	
❖ References	
❖ Arabic Summary	-

List Of Figures

<i>Figure</i>	<i>Page</i>
. Coronal section through the skull, Meninges and the brain.	5
. Organization of the brain.	8
. Lobes of the cerebrum seen from the left side.	9
. The cerebellum.	12
. Arteries of the superolateral surface of the left cerebral hemisphere.	15
. Arteries of the inferior surface of the left cerebral hemisphere.	17
. Veins of the brain and venous sinuses in lateral view.	20
. Major herniations of the brain.	51
. Signs of cerebral edema.	65
. Epidural hematoma and subdural hematoma.	69
. The normal appearance of the base of the brain.	208
. Cut section in the normal brain tissue.	209
. Cut section in the brain tissue showing the normal appearance of corpus callosum.	210
. A photomicrograph showing the normal appearance of the brain tissue.	211
. A photomicrograph showing the normal appearance of the axons.	212
. A photomicrograph showing the normal appearance of the axons.	213
-a. A contused wound in the left occipital region of the scalp.	214
-b. A compressed right parietal lobe from a large EDH.	215
-a. Internal localized contusion over the right parietal eminence.	216

-b.	Severe brain congestion.	217
-a.	Severe contusion in the scalp.	218
-b.	A photomicrograph showing SAH on the surface of the cerebellum.	219

List Of Figures

<i>Figure</i>	<i>Page</i>
. Brain congestion.	220
. A clotted SDH.	221
-a Subarachnoid hemorrhage and contusions.	222
-b. A photomicrograph showing axonal injury with bulb formation and retraction balls in the brain tissue.	223
-a. Subarachnoid hemorrhage.	224
-b. A photomicrograph showing SAH on the surface of cerebrum.	225
-c. A photomicrograph showing SAH filling a sulcus in the cerebrum.	226
-a. Intracerebral hemorrhage in the right temporo-parietal region.	227
-b. Hemorrhagic necrosis in the pons.	228
. Contusions in the cerebrum.	229
-a. Hemorrhagic infarction in the corpus callosum.	230
-b. A photomicrograph showing hemorrhagic infarction with hemosidren and RBCs in neural tissue.	231
. An area of liquefactive necrosis in the temporal lobe.	232
-a. A photomicrograph showing congestion in the brain tissue.	233
-b. A photomicrograph showing edema in the brain tissue.	234
-a. A photomicrograph showing ischemia in neural cells in grey matter in watershed area.	235
-b. A photomicrograph showing ischemia in purkenji cells of the cerebellum.	236

-c.	<i>A photomicrograph showing superficial tear and contusion in cerebral grey matter.</i>	237
-d.	<i>A photomicrograph showing superficial tear and contusion in cerebral grey matter with fibrin.</i>	238
-a.	<i>A photomicrograph showing focal SAH on the surface of the cerebellum.</i>	239
-b.	<i>A photomicrograph showing focal hemorrhage in the cerebral tissue.</i>	240

List Of Figures

<i>Figure</i>		<i>Page</i>
-	<i>A photomicrograph showing focal hemorrhage in the cerebellar tissue.</i>	241
c.		
.	<i>A photomicrograph showing healing infarction with new capillary formation lined by plumb of endothelial cells.</i>	242
.	<i>A photomicrograph showing fibrosis in the arachnoid mater.</i>	243
.	<i>A photomicrograph showing fibrosis of the arachnoid mater with superadded fresh SDH.</i>	244
.	<i>A photomicrograph showing axonal swelling in the brainstem.</i>	245

List of Abbreviations

ACA	Anterior cerebral artery
AI	Axonal injury
BBB	Blood brain barrier
CBF	Cerebral blood flow
CBV	Cerebral blood volume
CHI	Closed head injury
CNS	Central nervous system
cong.	Congestion
CPP	Cerebral perfusion pressure
CSF	Cerebrospinal fluid
CT	Computerized tomography
DAI	Diffuse axonal injury
EDH	Extradural / epidural hemorrhage
Fig.	Figures
GCS	Glasco coma scale
Hge.	Hemorrhage
HI	Head injury
hs	Hours
Hx & E	Hematoxylin and Eosin
ICH	Intracerebral hemorrhage
ICP	Intracranial pressure
MCA	Middle cerebral artery
MHI	Mild / minor head injury

ml	Milliliter
mm	Millimeter

List of Abbreviations

MMA	Middle meningeal artery
MRI	Magnetic resonance imaging
MSB	Martius scarlet blue stain
PCA	Posterior cerebral artery
RBCs	Red blood corpuscles
SAH	Subarachnoid hemorrhage
SDH	Subdural hemorrhage
TAI	Traumatic axonal injury
TBI	Traumatic brain injury
VS	Vegetative state
vs	Versus

Acknowledgment

"First of all thanks to
Allah"

I would like to present my sincere thanks and appreciation to **Prof. Dr. Magdi El-Meligi**, Professor of Forensic Medicine and Clinical Toxicology Faculty of Medicine, Ain Shams University, for his kind guidance and constant encouragement.

I would like to express my deepest gratitude to **Prof. Dr. Hanaa Mohamed Abdel Rahman**, Professor of Forensic Medicine and Clinical Toxicology Faculty of Medicine, Ain Shams University, for her great unlimited help, meticulous supervision, constant encouragement and guidance throughout this work.

I would like to present my sincere thanks to **Dr. Rasha El-Hossiny** Lecturer of Forensic Medicine and Clinical Toxicology Faculty of Medicine, Ain Shams University, for her great support, constant encouragement and close supervision throughout this work.

I would like to present my sincere thanks to **Dr. Haidy Abdel Hamid** Lecturer of Anatomy Faculty of Medicine, Ain Shams

University, for her great help, close supervision and constant guidance throughout this work.

I would like to present my sincere appreciation to **Dr. Hanan Hosny MD Pathology, Specialist of Forensic Pathology, Medicolegal Administration** for her great help and participation in this work.

I am deeply indebted to **All My Professors and Colleagues** in the Forensic Medicine and Clinical Toxicology Department, Faculty of Medicine, Ain Shams University, for their effective help and enthusiastic cooperation.

My deep thanks and great feelings extend to **All My Colleges** at the Medicolegal Administration - Cairo, Ministry of Justice, for their warm kindness and continuous support.

Last but not least, I wish to thank **All Members of My Family** for their real help, kind care and reassurance throughout my whole life.

Noha Sadek

Introduction

Blunt head injury is a leading cause of death and disability; it may affect the activities of daily life and increase the risk of re-admission to hospitals with subsequent death, and it can lead to ongoing neuropsychological deficits (*Pickett et al.,*).

Trauma to the head may damage the scalp, skull or brain. The most important consequence of head trauma is traumatic brain injury (TBI). Head injury may occur either as a closed head injury or as a penetrating head injury, as when a bullet pierces the skull. Severe injuries can be fatal because of profound brain damage (*Smith,*). Many deaths occur before admission to hospital and most of those occurring after admission happen within the first month (*Pentland et al.,*).

A head injury may cause damage both from the direct physical injury to the brain and from secondary factors, such as; lack of oxygen, brain swelling, and disturbance of blood flow. Both closed and penetrating head injuries can cause swirling movements throughout the brain, tearing nerve fibers and causing widespread bleeding or a blood clot in or around the brain. Swelling may raise pressure within the skull and may block the
