Management of Penetrating Intracranial Bullet Injuries

Thesis

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General Surgery

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To my Family

To my Family

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CONTENTS

List of Abbreviations

ABCDE	Airway, Breathing, Circulation, Disability And Exposure.
ABG	Arterial Blood Gas.
ALT	Alanine Transeaminase.
AP	Antero-posterior.
aPTT	Activated Partial Thromboplastin Time.
AST	Aspartate Transeaminase.
BBB	Blood Brain Barrier
BCT	Barbiturate Coma Therapy.
BP	Blood Pressure.
C°	Celsius.
CBC	Complete Blood Picture.
CBF	Cerebral Blood Flow.
CNS	Central Nervous System.
CO_2	Carbon dioxide.
CPP	Cerebral Perfusion Pressure.
CSF	Cerebrospinal Fluid.
CT	Computed Tomography.
DAI	Diffuse Axonal Injury.
DIC	Disseminated Intravascular Coagulation.
DPL	Diagnostic Peritoneal Lavage.
DRS	Disability Rating Scale.
DSA	Digital Subtraction Angiography.
E	Energy.
e.g.	For example.
EAC	External Auditory Meatus.
ED	Emergency department.
etc.	et cetera.
FAST	Focused Abdominal Sonography for Trauma.
FDA	Food and Drug Administration.
FIM	Functional Independence Measure.
G	Gram(s).
GCS	Glasgow Coma Scale.
GOS	Glasgow Outcome Scale.
GSW(s)	Gunshot wound(s).
i.e.	that is.
IC-HTN	Intracranial Hypertension.
ICP	Intracranial Pressure.
ICS	Inter Costal Space.

ICU	Intensive Care Unit.
IEDs	Improvised Explosive Devices.
IV	Intra Venous.
Kg	Kilogram(s).
L	Liter.
LOC	Loss of Consciousness.
m/s	Meter/Second.
MAP	Mean Arterial Pressure.
MCL	Mid Clavicular Line.
mL	Milliliter(s).
mm	Millimeter(s).
mmHg	Millimeter Mercury.
mmol	Millimoles.
mOsm	Milliosmole.
MRI	Magnetic Resonance Imaging.
ms	Millisecond(s).
OR	Operating Room.
P CO_2	Partial Pressure of Carbon dioxide.
PaO_2	Arterial Oxygen Tension.
PBI	Penetrating Brain Injury(-ies).
PEEP	Positive End Expiratory Pressure.
PET	Positron Emission Tomography.
PGCS	Pediatric Glasgow Coma Scale.
PT	Prothrombin Time.
PTA	Post-traumatic Amnesia.
RBCs	Red Blood Cells.
SAH	Subarachnoid Hemorrhage.
SAP	Systemic Arterial Pressure.
SPECT	Single-photon Emission Computed Tomography.
TBI	Traumatic Brain Injury (-ies).
TCDB	Traumatic Coma Data Bank.
TICA	Traumatic Intracranial Aneurysms.
TP	Thrombo Prophylaxis.
US	United States
VHIS	Vietnam Head Injury Study.
Vs	Versus.
VTE	Venous Thrombo Embolism.
V_0	Velocity.

List of Tables

List of Figures

Introduction & Aim of the Work

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Introduction of penetrating intracranial bullet injuries

Penetrating head injury, or open head injury, is a head injury in which the Dura mater, the outer layer of the meninges, is breached **(Pendlebury, 2007).** Head injuries caused by penetrating trauma are serious medical emergencies and may cause permanent disability or death .

Penetrating craniocerebral injuries are the leading cause of death from head trauma in the civilian population aged 35 to 75 years **(Doherty and Rabinowitz, 2004).** Men are far more likely to be victims of brain gunshot wounds (GSWs) than are women, with a peak incidence usually in the third and fourth decades. Suicides were most frequent in those 50 to 60 years of age, homicides predominated in the 20- to 30-year age group, and accidents occurred in children and teenagers (**Carey, 2004).**

Development of firearms in the 16^{th} century produced profound changes in the art of warfare and raised new problems for the physician-surgeons. Old assumptions and wrong interpretations delayed the rational approach to the head injuries inflicted by missiles. Evolution of thought and increased experience over the century ultimately led to a surgical practice that can be regarded as the possible solution allowed by contemporary knowledge and technology **(Viale, 2005).**

Gunshot wounds of the head are on the increase. The easy availability of handguns, revolvers, shotguns, and rifles and the continued and increasing armed struggle in various parts of the world demand a renewed and serious interest in and a better understanding of both the ballistic characteristics of missiles and the surgical pathology of missile wounds. Simple adherence to the general surgical principles of wound care leaves much to be desired when the neurosurgeon is confronted with a missile or gunshot wound of the brain **(Saba, 2000).**

The extent of civilian firearm injury has reached epidemic proportions in many countries across the world, developed and developing alike. Firearm injuries are among the top 10 causes of accidental death and the top dozen causes of all deaths in the United States, with numbers since World War II exceeding those killed in the wars of Vietnam and Korea combined, sadly there seems to be preponderance of adolescent and young adult victims, the majority of whom don’t survive to receive treatment **(Liebenberg et al., 2005).**

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Since gunshot wounds to the head remain a significant problem in the civilian population, any information that can be extrapolated from war injuries is valuable. War injuries are unique in being secondary to the higher velocity and higher kinetic energy of the projectile. Military bullets remain intact without undergoing fragmentation or deformation. The increased force of the blast associated with a war-time injury creates a larger volume of devitalized brain tissue, with a greater chance of a retained intracranial bone fragment. **(Rengachary et al., 2005).**

Victims of craniocerebral gunshot wounds (GSWs) were stabilized in the field by paramedic and ambulance crews. Patients in a coma were intubated if the attending staff had the expertise to do so. On admission, patients were treated according to the Advanced Trauma Life Support protocol. Patients, who were obviously in extremis, with fixed and dilated pupils, were maximally supported systemically until they were fit to be transported to the computed tomographic scan or until they died **(Liebenberg et al., 2005).**

Aim of the Work

Retrospective study of ten patients of penetrating intracranial bullet injuries who are admitted and managed at casualty & neurosurgery departments of Kasr el ainy and ministry of health hospitals.

Anatomical Considerations

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The brain is surrounded by cerebrospinal fluid (CSF), enclosed in meningeal covering, and protected inside the skull. Furthermore, the fascia and muscles of the scalp provide additional cushioning to the brain. Test results have shown that 10 times more force is required to fracture a cadaveric skull with overlying scalp than the one without **(Cantu, 1995).**

The scalp consists of five distinct anatomic layers. Listed from the most superficial to the deepest, these layers include: (1) the skin with its characteristic thick dermis; (2) the subcutaneous tissue; (3) the relatively rigid galea aponeurotica, which is continuous with the superficial musculo-aponeurotic system, frontalis, occipitalis, and superficial temporal fascia; (4) underlying areolar tissue; and (5) skull periosteum. The rich vascular supply of the subcutaneous layer, in which there is an abundant communication of vessels, can result in significant blood loss when the scalp is lacerated. The relatively poor fixation of the galea to the underlying periosteum of the skull provides little resistance to shear injuries, resulting in large flaps or "scalping" injuries. This layer's resultant potential space also provides little resistance to hematoma or abscess formation. As a result, extensive fluid collections related to scalp injury tend to accumulate in the subgaleal plane **(Yaremchuk and Rubin, 2000).**

The causative forces and fracture pattern, type, extent, and position are important in assessing the sustained injury. The skull is thickened at the glabella, external occipital protuberance, mastoid processes, and external angular process and is joined by 3 arches on either side. The skull vault is composed of cancellous bone (diploë) sandwiched between 2 tablets, the lamina externa (1.5 mm), and