Early Systolic Dysfunction Following Traumatic Brain Injury

Thesis for Partial Fulfillment of Master Degree in Intensive Care

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- **TBI**: Traumatic Brain Injury.
- **SAH**: subarachnoid hemorrhage.
- **IV**: Intravenous.
- **ICU**: Intensive care unit.
- **GCS**: Glasgow coma score.
- **RBCs**: Red blood cells.
- **CT**: Computed tomography.
- **TTE**: Transthoracic echocardiography.
- **CBC**: Complete blood count.
- **HB**: Hemoglobin.
- **WBCs**: White blood cells.
- **INR**: International randomized ratio.
- **Na^+**: Sodium.
- **K^+**: Potassium.
- **CSF**: cerebrospinal fluid.
- **ICP**: Intracranial pressure.
- **PTA**: Post-traumatic amnesia.
- **MTBI**: Mild traumatic brain injury.
- **BBB**: Blood brain barrier.
- **CBF**: Cerebral blood flow.
- **BTF**: Brain Trauma Foundation.
- **AMY**: Amygdala.

- **DAD**: Delayed after depolarization.
- **EAD**: Early after depolarization.
- **Hypo-T**: Hypothalamus.
- **NTS**: Nucleus tractus-solitaries.
- **PAG**: Periaqueductal grey.
- **PBN**: Parabrachial nucleus.
- **THAL**: Thalamus.
- **VF**: Ventricular fibrillation.
- **VLM**: Ventrolateral Medulla.
- **VMPFC**: Ventromedial prefrontal cortex.
- **cTnT**: Cardiac Troponin T.
- **cTi**: Cardiac Troponin.
- **RWMA**: Regional wall motion abnormality.
- **BNP**: B-type natriuretic peptide.
- **SRI**: Strain rate imaging.
- **RTMCE**: Real time myocardial contrast echocardiography.
- **TNFα**: Tumor necrosis factor alpha.
- **MULTITUDE-HF**: Multiparametric Heart Failure.
- **ICD**: Implantable cardioverter-defibrillator.
- **SBP**: Systolic blood pressure.
- **DBP**: Diastolic blood pressure.
- **HR**: Heart rate.
- **RR**: Respiratory rate.
- **Temp**: Temperature.

- **LVEDD**: Left Ventricular end diastolic diameter.
- **LVESD**: Left Ventricular end systolic diameter.
- **RVEDD**: Right Ventricular end diastolic diameter.
- **IVSED**: Interventricular septal end diastole.
- **LVpost wall thickness ED**: Left Ventricle posterior wall thickness at end diastole.
- **FS**: Fractional Shortening.
- **LVEF**: Left ventricle ejection fraction.
- **LV**: Left ventricle.

The Protocol

Introduction

In Egypt, road traffic accident was the commonest cause of trauma in 73.7% of the patients. 62.1% of the patients had mild head injury, 17.5% of the patients had moderate head injury, while the remaining 20.3% had severe head injury. Brain contusions, brain edema, and epidural hematoma were the commonest traumatic pathology in 39.1%, 36.5%, 17.6% respectively. 63.6% of the patients had associated injuries rather than head injury. Good recovery was reported in 62.7% of the patients, moderate disability in 12.1% of the patients, while the mortality rate was 14.3% of the patients **(Taha and Barakat, 2016).**

Another study searching for the leading causes of TBI in Egypt in 2010, found Male sex was predominantly affected, 79% of cases. Moderate and severe injuries account for 17.2% of all TBI presented cases **(Montaser and Hassan, 2013).**

Patients with moderate-severe TBI experience hypotension (defined commonly as systolic blood pressure [SBP], <90 mm Hg) early after hospitalization **(Mascia et al., 2008)**, which can lead to poor blood flow to an injured brain **(Jeremitsky et al., 2003)** and worse mortality and functional outcomes following TBI **(Zafar et al., 2011)**.

Experimental studies and clinical observations in other non-TBI neurologic disease paradigms, such as subarachnoid hemorrhage (SAH), suggest that acute systolic cardiac dysfunction may be responsible for the early hypotension that is often associated with catastrophic neurologic processes **(Samuels 2007)**.

The approach to fluid management and selection of vasoactive agents should be directed by the status of cardiac function in TBI. Some data suggest that IV phenylephrine is the most commonly used vasopressor following severe TBI **(Sookplung et al., 2011)**. However, without knowledge of the status of the heart, it is difficult to examine which vasoactive agent will best improve cerebral perfusion in an individual TBI patient.

Outside of a retrospective study **(Prathep et al., 2014)** and case reports **(Krishnamoorthy et al., 2013)**, there are little prospective data on what happens to cardiac function after TBI.

It is hypothesized that systolic dysfunction would be relatively common after moderate-severe TBI, and greater TBI severity would result in more systolic dysfunction.

Aim of the work

The study aims to determine the longitudinal course, and admission risk factors for systolic dysfunction in patients with isolated moderate-severe TBI.

MATERIALS AND METHODS

- **Type of study:**

Prospective cohort study.

- **Study setting:**

ICU department Ain Shams university hospitals.

- **Study period:**

October 2017 to August 2018.

- **Study population:**

-*Inclusion criteria:*

- Patients diagnosed of mild TBI and moderate-severe TBI within 24 hours of injury and TBI severity was based on the admission Glasgow Coma Scale (GCS) score after resuscitation. Mild TBI was defined by a GCS score greater than or equal to 13, and moderate-severe TBI was defined by a GCS score less than or equal to 12.

-*Exclusion Criteria:*

- Patients more than 65 years old and any patient with a documented history of ischemic heart disease, congenital heart disease, moderate or severe valvular heart disease, and systolic or diastolic heart failure.
- Patients with severe systemic comorbidities (liver cirrhosis > stage 2 chronic kidney disease, human immunodeficiency virus infection.
- A history of chemotherapy, > stage 2 chronic obstructive pulmonary disease, pulmonary hypertension, or a history of cerebrovascular disease.