UNIVERSITI PUTRA MALAYSIA

CLINICAL OUTCOME OF TRAUMATIC BRAIN INJURY PATIENTS WITH FEVER IN A PUBLIC HOSPITAL IN MALAYSIA

ADILAH BINTI TASMAN

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By

ADILAH BINTI TASMAN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

March 2021

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DEDICATION

I would like to dedicate this thesis and achievement to my old version.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

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March 2021

Chairman : Professor Soh Kim Lam, PhD
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Introduction: Fever has been known as one of the most common causes of traumatic brain injury (TBI) insults leading to mortality or morbidity. Monitoring and early detection of fever, as well as prevention of fever are said to be the keys to prevent or limit secondary injury in TBI, placing personnel within critical care facilities on the front line. The situation triggered the need for a study to identify the root causes of fever leading to mortality among TBI patients. **Objectives:** The present study was undertaken to investigate the occurrence of fever and its association with clinical outcomes among TBI patients. **Materials and method:** The study included 38 patients admitted and diagnosed of TBI for more than 48 hours at Hospital Tuanku Jaafar, Seremban (HTJS) from January to December 2016. Four-hourly patients' body temperatures and fever interventions were recorded until a 7-day after critical-care admission or discharge, whichever occurred first. The outcomes of TBI patients with fever were measured using Glasgow Coma Scale (GCS) scores and survival status upon discharge from critical care facility. **Results:** Frequency of body temperatures of more than 37.4^{o}C were recorded to be occurred in 32 among 38 patients within seven days of critical-care admission. Approximately 84.3% of these patients were admitted with severe GCS score (8-3), and discharged with mild GCS score (14-15) (43.8%). The fever interventions were started at body temperature of more than 38.2^{o}C with n=22. Pharmacological administration was the most common intervention used (50.0%) followed by combination methods of pharmacological administration and physical cooling methods (31.8%); and application of physical cooling method only (9.1%). There was no significant association between fever occurrence and poor clinical outcome, χ^2 (2, N=38) = 0.361, p>.05. **Conclusion:** There was no relationship between occurrences of fever during critical-care admissions and poor clinical outcomes. It reports an insight on the impact of fever among TBI patients and may contribute to health care providers with management and intervention strategies in reducing fever occurrences and thus improving patients' outcomes.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

KESAN KLINIKAL PESAKIT YANG MENGALAMI KECEDERAAN OTAK TRAUMATIK DISERTAI DEMAM DI SEBUAH HOSPITAL AWAM DI MALAYSIA

Oleh

ADILAH BINTI TASMAN

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Pengerusi : Profesor Soh Kim Lam, PhD
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Pengenalan: Demam telah dikenalpasti sebagai salah satu punca gangguan berikutan kecederaan otak disebabkan trauma (TBI) yang membawa kepada kematian dan morbiditi, yang merujuk kepada masalah perubatan yang disebabkan oleh sesuatu rawatan. Pemantauan dan pengesanan awal demam, beserta pencegahan demam telah diperkatakan sebagai kunci bagi mengelak atau menghad berlakunya gangguan sekunder dalam TBI, sekaligus meletakkan kakitangan di fasiliti penjagaan kritikal berada di barisan hadapan. Keadaan ini mencetuskan keperluan untuk mengkaji punca penyebab demam yang membawa kematian dalam kalangan pesakit TBI.**Tujuan:** Kajian ini telah dijalankan untuk menyelidiki kejadian demam serta hubungannya dengan hasil klinikal dalam kalangan pesakit TBI. **Bahan dan kaedah:** Kajian terdiri daripada 38 pesakit yang didaftar masuk dan diberi diagnosis TBI selama melebihi 48 jam di Hospital Tuanku Jaafar, Seremban (HTJS) dari Januari hingga Disember 2016. Suhu badan pesakit yang diambil setiap empat jam dan rawatan demam telah direkod sehingga 7 hari kemasukan untuk penjagaan kritikal atau selepas daftar keluar bergantung kepada yang mana terdahulu berlaku. Kesudahan pesakit TBI yang mengalami demam telah diukur dengan menggunakan skala Glasgow Coma Scale (GCS) dan status hidup pesakit selepas keluar dari fasiliti penjagaan rapi. **Keputusan:** Kekerapan suhu badan yang melebihi 37.4^{o}C telah direkodkan dialami oleh 32 orang daripada jumlah 38 pesakit sepanjang tujuh hari di bawah penjagaan rapi. 84.3% daripada pesakit-pesakit ini telah dimasukkan ke unit jagaan rapi dengan skor GCS teruk (8-3), dan skor GCS ringan (15-14) ketika discaj (43.8%). Rawatan demam dimulakan pada suhu badan melebihi 38.2^{o}C dengan n=22. Rawatan farmakologi merupakan rawatan yang paling biasa digunakan (50.0%) diikuti oleh kombinasi rawatan farmakologi dan kaedah penyejukan fizikal (31.8%); dan penggunaan tunggal kaedah penyejukan fizikal (9.1%). Tiada perhubungan signifikan antara kejadian demam dengan hasil tidak memuaskan, χ^2 (2, N=38) = 0.361, p>.05. **Kesimpulan:** Tidak

terdapat hubungkait antara berlakunya demam semasa kemasukan ke penjagaan rapi dengan hasil klinikal yang tidak memuaskan. Laporan ini memberi gambaran tentang kesan demam ke atas pesakit TBI dan boleh memberi sumbangan kepada penyedia perkhidmatan kesihatan dalam strategi pengurusan dan intervensi demam serta mengurangi kejadian demam dan seterusnya meningkatkan hasil klinikal para pesakit.

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This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

BOR	Bed Occupancy Rate
$CMRO_2$	Cerebral Metabolic Rate for Oxygen
CNS	Central Nervous System
CSF	Cerebrospinal Fluid
CT	Computed Tomography
DAI	Diffuse Axonal Injury
DGCS	Discharged Glasgow Coma Scale
EDH	Extradural Hemorrhage
GCS	Glasgow Coma Scale
HDU	High Dependency Unit
ICH	Intracranial Hemorrhage
ICP	Intracranial Pressure
ICU	Intensive Care Unit
SAH	Subarachnoid Hemorrhage
SDH	Subdural Hemorrhage
TBI	Traumatic Brain Injury

CHAPTER 1

INTRODUCTION

1.1 Background

Traumatic brain injury (TBI), in simpler and understandable language, is a sudden damage to the brain caused by an external blow or jolt to the head. Usual sincauses include collisions, falls, sports accidents and assaults by car or motorcycle. Menon, Schwab, Wright and Maas, (2010) described TBI as an alteration in brain functions such as loss of consciousness and neurological deficits or other evidsingleences of brain pathology. TBI and head injury are two terms that are commonly used interchangeably. In factuality, the former is basically an injury involving brain and its surrounding. The latter is used to describe much broader conditions such as injuries to the face and scalps without underlying brain damage (Roozenbeek, Maas, & Menon, 2013; Pushkarna, Bhatoe & Sudambrekar, 2010). In the present study, the term 'head injury' was not being used.

TBI is commonly classified as primary and secondary TBI. Primary brain injury happens at the time of impact, involving focal brain injury (due to types of contact injury) and diffusing brain injury, which is due to types of acceleration /deceleration injury. The effect caused by focal brain injury is typically laceration, contusion and intracranial haemorrhage, whereas diffuse brain injury may lead to diffuse axonal injury or brain swelling. At the moment of impact, the injury caused are usually irreversible and cannot be modified as not only the blood brain barrier are destructed, but also meninges and neurons may be damaged or die.

Fever following TBI has been proven to be a potential threat to brain, when the occurrence of injury significantly affected vascular, metabolic and neuronal parameters (Bohman & Levine, 2014; Chowdhury, Kowalski, Arabi, *et al.*, 2014; Mrozek, Vardon & Geeraerts, 2012). Fever also has been reported to occur very frequently among patients with TBI (Bengualid, Talari, Rubin, *et. al*, 2015; Nyholm, 2015; Bao, Chen, Ding, Ling & Xu, 2014; Saxena, Taylor, Hammond, *et al.*, 2013; McIlvoy, 2012; Thompson & Kagan, 2011). A recent study indicated 43% of the patients with TBI had fever during their hospital stay (Saxena *et al.*, 2013).

Cerebral metabolism typically varies linearly with brain temperature (7 to 13 per cent increase in cerebral metabolism for every 1^{o}C increase in core body temperature) (Childs & Lunn, 2013). Therefore, fever, which is an increase in the temperature of the human body, indirectly causes the cerebral metabolic rate

to rise. Increased cerebral metabolic rate resulted in increased cerebral blood flow to provide both oxygen and glucose (Mrozek, *et al*., 2012). The increase in cerebral blood flow in TBI patients is considered to be potentially lethal, as it increases brain volume and intracerebral pressure (Li & Jiang, 2012).

Management of fever appears to be an easy task in nurses' daily routine. However, when involving patients with TBI, fever management can become controversial, whether to maintain normothermia or to induce hypothermia (Johnston, 2011). Vigilant monitoring and early detection of fever are said to be the keys to prevent or limit secondary brain injury among patients with TBI (Dash & Chavali, 2018; Haddad & Arabi, 2012; McCallum & Higgins, 2011). Hence, critical care nurses play a vital role in detecting and monitoring any changes in patients' body temperature. The nurses also have the responsibility for correctly and accurately measuring patients' body temperature, documenting and determining whether the changes require notification, intervention or both (McIlvoy, 2012).

Despite proposed practices, the outcome TBI patients with fever is still the main concern. The main aim of fever management among these patients is to optimize the outcomes upon discharge, which includes better Glasgow coma scale (GCS) score, (a neurological scale that seeks to document the state of consciousness of a person accurately and objectively), shorter hospital stays and lower morbidity.

1.2 Problem statement

It was reported that there was an increase of total road accidents in the state of Negeri Sembilan from from 22, 939 road accidents in year 2015 growing to 24,428 in 2016 (Ministry of Transport Malaysia, 2017). Therefore, road accidents also have been recorded to be one of the most common cause to local hospital admission (82-72.6%) (Affirul, Mohamed, Firdaus, *et* al., 2019), with 31.7% of the accidents involving trauma to head and neck region (Nik Hisamuddin, *et* al., 2015). The concern was, majority of the cases comprise of 89.4% male gender, aged between 15-34 years old (Affirul, Mohamed, Firdaus, *et* al., 2019; Mardhiah, 2017) who would be valuable assets to the future.

One of the key management to improve the prognosis of these victims is to prevent the secondary injury. Recent studies had recorded that the number of mortality due to secondary insults following brain injury had been increasing over the years (Volpi, Robba, Rota, Vargiolu & Citerio, 2018; Johannigman, Zonies, Dubose, Blakeman, Hanseman & Branson, 2015; Dukes, Bridges, & Johantgen, 2013). Fever, as one of the most common causes of this injury have to be managed well in order to reduce the number of mortality and morbidity among patients.

The present study's objective was to examine the relationship of fever occurrence and outcome of patients with TBI in the critical care facilities with the aim to identify the appropriate interventions used in the management of fever. The knowledge gap exists on how fever impacts the outcome of patients with TBI at a local critical care facility. If current management of fever could not optimize patients' outcome, there is a need to improve the practices of critical care nurses in critical care facilities.

1.3 Significance

At present, in Malaysia, there have been no comprehensive reports on the outcome of TBI patients with fever in critical care facilities. The present study could be importance to the following:

Patients' and society's wellness. The immediate goal of TBI's treatment is to prevent further injury to the brain itself. This is to ensure the patients may return to the most possible pre-injury life. The present study is hoped may discover the trends of outcome of fever or insult following TBI besides offering an overview of interventions that may improve the patients' outcome.

Nursing profession and other clinicians. Since the study was also aimed at identifying and describing clinical interventions used in the current practices in overcoming fever among TBI patients, it is hoped that the study findings may provide better information for more effective intervention approach for this situation.

Future researchers. The present study was intended to contribute significantly to existing literature and to propose practical solutions in the area of management of fever. The data acquired is hoped may be used as reference and overview in conducting new researches.

1.4 Research Aims and Questions

his present study was undertaken to fulfil the following objectives:

1.4.1 General objective

The main purpose of the study was to investigate the occurrences of fever and its impact on clinical outcomes TBI patients in critical care facilities.

1.4.2 Specific objectives

The specific objectives of the present study were as follows:

i. to determine the characteristics of patients with TBI
ii. to determine the characteristics of fever among patients with TBI;
iii. to determine the clinical outcomes of fever among patients with TBI
iv. to identify nursing interventions used in the management of fever among patients with TBI;
v. to examine the association of fever with clinical outcomes among patients with TBI.

1.4.3 Research questions

Research questions raised from the study were as follows:

i. what are the characteristics of patients with TBI?
ii. what are the characteristics of fever among patients with TBI?
iii. what are the clinical outcome of fever among patients with TBI?
iv. what were the nursing interventions used in the management of fever among patients with TBI?
vi. is there any association between fever and clinical outcomes among patients with TBI?

1.5 Hypothesis

H^1 - There is a significant association between fever and clinical outcomes among patients with TBI.

1.6 Overview of thesis

The thesis is carried out in six chapters. Each chapter is linked to an important part of the research method.

Chapter 1 delivers the study's context and significance. The purposes and goals of the study and research questions are addressed. The description and framework of the study is outlined.

Chapter 2 focuses on concepts of brain injury, including types of brain injury, as well as aspects of elevated body temperature, such as increases in body temperature, fever, and hyperthermia. The biological mechanism by which

increased body temperature affects outcome is also discussed in this chapter. The literature also discusses the characteristics of fever in TBI, the relationship between clinical outcomes and fever, current clinical interventions, and the effectiveness of fever-reduction strategies.

Chapter 3 offers a summary of the approaches used to answer study problems and the reasons for methodological decisions. This include the definition of the research methods which consist of study design, research setting, sample selection, procedure, data collection, statistical analysis and ethical concern.

The study results are discussed in Chapter 4 within the context of the three research questions. A debate on the outcomes and comparison with current theoretical literature is given in Chapter 5. The thesis ends with implications for nursing practise , education and further study and recommendations. In the chapter, the limitations of analysis are also described.

1.7 Summary

The adverse effects of fever reported in different literatures indicate that fever is exacerbating the clinical outcome of neurologically damaged patients. There is hypothesis that fever in TBI patients is associated with bad outcomes. Fever that impacts the outcome of patients is a major clinical challenge that deserves appropriate strategies for management.

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Adilah binti Tasman, born on April 7, 1987 in Johor. At Kolej Islam Sultan Alam Shah, Klang, Selangor, she had continued her secondary school. Subsequently, she had her study in Universiti Teknologi MARA's nursing program with JPA scholarship after completing a one-year matriculation course in Johor.

She was given two years of work at Alor Setar after graduation before being moved to Kuala Pilah until the present.

In 2015, she pursued a Master of Science at Putra Malaysia University in order to explore her real passion in the field of nursing. She has experienced so many first-time encounters during this journey, and has taken this as opportunities and learning experience.

She was thankful for this opportunity, the lesson in life and hopes that what she has learned from this experience will lead her to make better and wise decisions in future.

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