PATTERN OF ADMISSION AND OUTCOME OF PATIENTS IN TRAUMA INTENSIVE CARE UNIT, EMERGENCY DEPARTMENT, HOSPITAL UNIVERSITI SAINS MALAYSIA

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LIST OF ABBREVIATIONS

TICU	Trauma Intensive Care Unit
HUSM	Hospital Universiti Sains Malaysia
A+E	Accident and Emergency
ED	Emergency Department
GCS	Glasgow Coma Scale
RTS	Revised Trauma Score
APACHE	Acute Physiology and Chronic Health Evaluation
AKI	Acute kidney injury
SBP	Systolic blood pressure
RR	Respiratory rate

MVA Motor vehicle accident

ABSTRAK

Latar belakang

Trauma major merupakan salah satu punca utama kemasukan hospital dan mengakibatkan perbelanjaan besar dalam bajet kesihatan. Unit Rawatan Rapi Trauma (TICU) memainkan peranan penting dalam rantaian perkhidmatan rawatan trauma demi pemulihan dan penjagaan kritikal agar dapat menambaikkan peluang hidup pesakit. Kajian ini dijalankan untuk mengetahui faktor-faktor peramal demografi yang boleh menjejaskan peluang hidup pesakit di Trauma ICU, HUSM.

Tatacara Kajian

Kajian ini dijalankan secara pemerhatian dan retrospektif diTICU, Hospital Universiti Sains Malaysia (HUSM) bermula 1 Jan 2016 hingga 31 Disember 2018.

Keputusan

Sebanyak 108 pesakit trauma terlibat dalam kajian ini. Lelaki didapati 6 kali lebih kerap terlibat dalam trauma berbanding perempuan. Kebanyakan kes merupakan trauma tumpul (99.1%) dan berpunca daripada kemalangan jalan raya (92.6%). Tujuh puluh enam peratus pesakit diintubasikan manakala 7.8% meninggal dunia di ICU. Mengikut pemarkahan klinikal dalam trauma, 25% (p= 0.001) pesakit yang GCS < 4, 46.9% (p= 0.000) dengan RTS < 5.5, dan 15.6% (p= 0.012) dengan APACHE II > 28 tinggal di TICU lebih dari 7 hari. Manakala 62.5% (p= 0.000) pesakit yang GCS < 4, 75% (p= 0.000) dengan RTS < 5.5 dan 75% (p= 0.000) dengan APACHE II > 28 menunjukkan kematian di TICU. Pesakit trauma yang tinggal lebih 7 hari di ICU akan diintubasi dan memerlukan pertolongan pernafasan dengan setinggi 4 kali ganda (adj B= 4.012; p= 0.021). Kemasukan pesakit trauma ke ICU lebih 7 hari meningkatkan risikosebanyak 8.5 kali ganda untuk mengidap sepsis (adj OR= 8.532; 95% CI: 2.710, 26.863; p= 0.000) dan 7 kali ganda untuk mendapat kerosakan buah pinggang (AKI) (adj OR= 7.131; 95% CI: 1.464, 34.733; p= 0.015). Transfusi darah pula meningkatkan risiko sebanyak 5 kali ganda untuk mendapat rabdomiolisis (pembinasaan otot) (adj OR= 4.968; 95% CI: 1.821, 13.549; p= 0.002).

Kesimpulan

Penggunaan pemarkahan trauma klinikal adalah amat sesuai kerana terdapat hubungkait yang kuat dalam menilai risiko kematian dan tempoh pesakit berada di TICU. Pertolongan pernafasan melalui intubasi dan juga komplikasi trauma berhubung kait dengan tempoh pesakit berada di TICU.

Kata kunci:

Unit rawatan rapi trauma, faktor peramal dan demografi, kesan jangka panjang

ABSTRACT

Background

Major trauma is one of the main causes of hospitalization and consumes a significant amount of health care budget. The role of Trauma ICU (TICU) is vital in the chain of trauma care to ensure rehabilitation and sustainable critical care for a better survival outcome. This study is conducted to find out demographic patterns and predictors that can affect the outcomes of trauma patients.

Methodology

This retrospective, observational study was conducted in TICU, Hospital UniversitiSains Malaysia (HUSM) between January 1, 2016 and December 31, 2018.

Results

A total of 108 trauma patients were included in this study. Males were 6 times more likely than the females to sustain trauma. All cases were exclusively blunt trauma (99.1%) and mainly attributed to road traffic accidents (92.6%). Approximately seventy six percent were intubated and 7.8% died in ICU. In terms of trauma clinical scoring, 25% (p= 0.001) with GCS score < 4, 46.9% (p= 0.000) with RTS score < 5.5 and 15.6% (p= 0.012) with APACHE II score > 28 demonstrated prolonged ICU stay (> 7 days). Meanwhile 62.5% (p= 0.000) with GCS < 4, 75% (p= 0.000) with RTS < 5.5 and 75% (p= 0.000) with APACHE II > 28 died in TICU. Trauma patients who had prolonged ICU stay demonstrated 4 times higher odds to be ventilated (adj B= 4.012; p= 0.021). Besides that, those who had prolonged ICU stay were 8.5 times higher odds to get sepsis (adj OR= 8.532; 95% CI: 2.710, 26.863; p= 0.000) and 7 times higher odds to get AKI (adj OR= 7.131; 95% CI: 1.464, 34.733; p= 0.015). Blood transfusion led to 5 folds higher odds in rhabdomyolysis in trauma (adj OR= 4.968; 95% CI: 1.821, 13.549; p= 0.002).

Conclusion

Clinical scoring in trauma has stronger association to predict mortality than length of ICU stay. Ventilation period and trauma related complications are closely related with length of ICU stay.

Keywords:

trauma intensive care unit, pattern, admission, predictor, outcome

CHAPTER 1: INTRODUCTION

1.1 Background

Trauma is a major health problem and a leading cause of mortality and morbidity among adults in the world. In Malaysia, the number of road accidents was 521, 466 in 2016, a steady increase from 489, 606 in 2015 (Transport Ministry, New Straits Times reports). The fatality was 6, 570 in 2016, an increase from 6, 193 cases in 2015. The rising trend of the road traffic accidents becomes a huge burden to our healthcare system especially Emergency Medical Service across the country. Each year the Ministry of Health has

stipulated a comprehensive budget for the high expenses and resources from prehospital care to the ambulance service to emergency department units to cater the workload and upgrade the facilities and equipment. Hence the setup of trauma intensive care unit plays a pivotal role in our healthcare system to meet the rising demands and increasing trend of road fatalities to improve the quality of care in trauma management.

According to Malaysia National Trauma Database report in 2009, the majority of the injuries admitted to Emergency Department was from blunt trauma (96.3%). A high percentage of injuries were due to road traffic accidents (76.8%). During hospital admission, 56.8% of the patients receive ICU care. The younger age group (15-34 years: 56.6%) was at the higher risk of major trauma. Most of the major trauma patients had injuries to the head and neck (85.4%) and half of the major trauma patients underwent surgery (51.33%) for intracranial injuries (63.6%). The survival rate was 72.1%, and the average length of stay is between 8-18 days.

Study analysis from Trauma Surgery Registry report 2011-2012 conducted at Hospital Sultanah Aminah Johor Bahru concluded that injury due to road traffic accidents is the most common cause of admission (82.5% of trauma cases) in Emergency Department. Approximately a third of cases required ICU admissions. Overall case fatality was 11.06%, all of them sustained major trauma and majority was motorcyclists.

There is no study yet that has been conducted to analyse the patterns of admission and outcome of patients in Trauma Intensive Care Unit of Hospital UniversitiSains Malaysia. I hope that this study can be a landmark study to improve our trauma care overall and to

deliver the best service to our major trauma patients in terms of cost, benefit and patient outcome. Only then we can know our limitations and shortfalls and then we can formulate a more comprehensive review of the resource and the workload, the manpower (doctors and paramedics), the equipment and the facilities, and lastly to improve level of care in Emergency Department and Trauma ICU of Hospital UniversitiSains Malaysia.

1.2 Literature Review

Trauma resulting from road traffic accidents is a leading cause of intensive care utilization in the world today (Chalya et al., 2011), consumes a significant amount of healthcare budget. Almost 30% of intensive care unit admission is due to trauma (Stefania Mondello et al., 2014), (Amy C. Gunning et al., 2015), (Onyekwulu FA et al., 2015), (Portal Trauma Registry Report 2011-2012, Malaysia), (The National Trauma Database 2009- Fourth Report, Malaysia).

Patterns of admission range from demographic data to injury details. According to the National Trauma Database 2009-Fourth Report, Malaysia, the males were about 6 times more likely than the females to sustain trauma (male 86.6% vs female 13.4%). The younger age group (15-34 years) constitutes the highest risk of major trauma (56.6%). From the 2061 cases of major trauma, 52.9% involved Malays and 12.9% involved foreigners. Majority of injuries was from blunt trauma (96.3%), most of them was unintentional (91.2%) and most of them was due to road traffic accidents (76.8%). About 25.9% of cases was sent directly to operating theatre from ED, another 21% of cases was admitted to ICU from ED. About half (49.8%) of the major trauma patients had a

Glasgow Coma Scale (GCS) of 3-8. One in every five major trauma patients had a low revised trauma score (RTS) of less than 5.0.

The outcome ranges from survival to length of stay in ICU. The survival rate for major trauma patients was 72.1%. The survival rate reduced from 88% to 57.8% for GCS 13-15 to GCS 3-8 respectively. Patients who had a revised trauma score (RTS) of more than 5 had better outcome, survival rate of more than 65%. The average length of stay is 8-18 days.

Some of the predictors or complications that we can look into in patients who were admitted to trauma ICU were post- op complications, prolong mechanical ventilation, sepsis, multiple blood transfusions, rhabdomyolysis, acute kidney injury, fat/ pulmonary embolism etc (Stefania Mondello et al., 2014).

The identification of the epidemiology, patterns, and causes of complications following trauma can provide useful information for improving treatment strategies, outcomes, costs and ultimately the quality of health system (Stefania Mondello et al., 2014).

By evaluating the incidence and type of complications occur after trauma among critically ill patients admitted to ICU, we can determine the independent predictors of complications and mortality and morbidity in trauma ICU setting in the long run (Stefania Mondello et al., 2014), (Chalya et al., 2011).

1.3 Problem Statement and Study Justification

1. Trauma ICU is a new establishment in Malaysia. As the trauma incidence rate is increasing yearly, the general ICU in Malaysia is facing shortage of beds to cater other departments, namely medical, surgical, pediatrics and orthopedics emergency cases. Hence the idea of trauma ICU has been suggested to reduce the unnecessary access block or workload strain for ICU admissions.

2. Emergency medicine in our country is a young and vibrant field.With just 20 years of establishment in this country, the concept of acute trauma care and response is still not well understood by many other various departments. Although the existence of trauma ICU is at the juncture of infancy, it's a good start to implement a better trauma care and response at the initial phase of admission beginning from emergency department and at the same time maintaining utmost professionalism of doctor to patient care in the ICU for subsequent long-term care and management.

3. Studies or published journals about our trauma ICU are limited in our country. It's necessary and timely to start the basic data recruitment, from demographic and background information, to the patterns of admission, mechanisms and types of injury, diagnosis in emergency department, criteria for ICU admission, role of surgery, outcome of ICU stay, complications etc. Hopefully through this study, we can be better and more experienced in managing trauma care at the best level in terms of resources, equipment, beds occupancy, staff and manpower skills, and other areas of interest.

1.4 Benefit of the Study

1. An objective method of trauma data collection for assessment and review of the current status of intensive care service especially trauma care with special reference to its demand, clinical practice, performance, outcome of patients and resource utilization of ICU.

2. More organized and systematic data information about reason for ICU admission, types of organ failure, presence of co-morbidities, types of intervention and monitoring, complications, in-ICU outcome in terms of length of stay. This can provide a thorough and valuable evidence to improve the necessary tasks and challenges that trauma ICU of HUSM is facing in terms of workload or access block for ICU admission etc.

3. Highlight on advance training of the paramedics and staffs from prehospital services to emergency departments to trauma ICU to fill the gap and the shortfalls or weaknesses of the trauma care and management in general.

1.5 Research Questions

1. What is the overview of patient's demographics?
2. What are the patterns of admission?
3. What is the outcome of the patient?

1.6 Research Objectives

General objective:

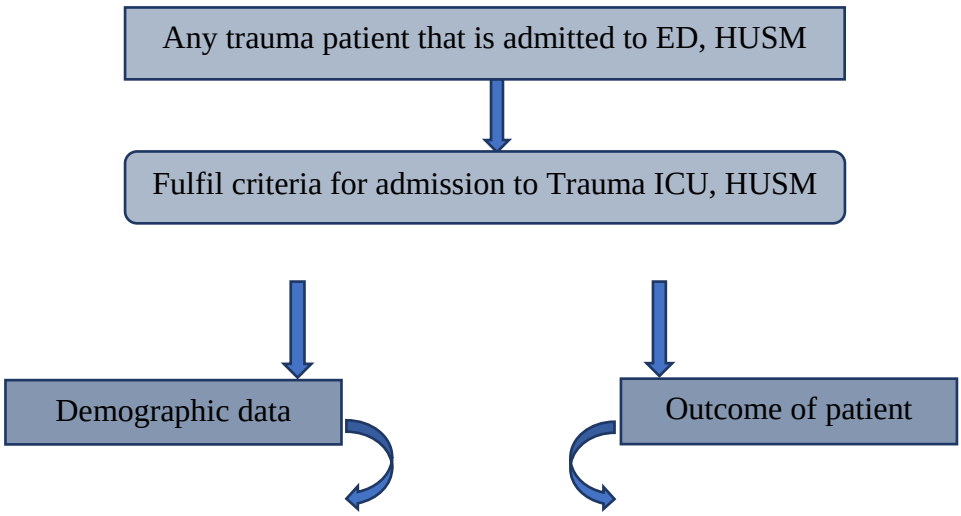
To describe the patterns of admission and outcome of patients admitted to TICU, HUSM

Specific objective:

1. To determine the demographics pattern of patient admitted to TICU (gender, age, race, injury mechanism, type of injuries, primary team, Glasgow Coma Score (GCS), revised trauma score (RTS), acute physiology and chronic health evaluation (APACHE) score.
2. To determine the outcome of patient: blood transfusion, length of ICU stay, duration of mechanical ventilation, mortality, trauma related complications (rhabdomyolisis, AKI, fat/pulmonary embolism, sepsis)
3. To determine the demographic factors associated with patient outcome

CHAPTER 2: STUDY PROTOCOL

2.1 Conceptual Framework



Data collection form

2.2 Research Design

This is a 1year retrospective observational study conducted between Jun 2016 till May 2017 which includes all the patients that fulfil the inclusion and exclusion criteria to admit to Trauma intensive care unit, Hospital UniversitiSainsMalaysia.

2.3 Study Area

Trauma intensive care unit, Hospital UniversitiSains Malaysia

2.4 Study Population

All trauma patients admitted to Emergency Department, Hospital UniversitiSains Malaysia.

2.5 Subject Criteria

Inclusion Criteria

All trauma patients admitted to Trauma ICU through Emergency Department, Hospital USM

Exclusion Criteria

All other ICU cases which are transferred in from General ICU/ wards

2.6 Sampling Method and Subject Recruitment

No sampling method will be applied in this study. Instead, a universal sampling is done in which all patients who fulfilled the inclusion and exclusion criteria will be included in

the study. The number of patients per month is around 8-9 (roughly 96-108 patients per year) and the sample size needed is 107 patients.

Operational definition

Revised Trauma Score (RTS)

The Revised Trauma Score is a physiologic severity score that can be a useful triage tool and is an accurate predictor for the probability for survival. This score assigns coded values for 3 parameters, namely the first recordings of the Glasgow Coma Scale, systolic blood pressure and respiratory rate as below;

Glasgow Coma Scale (GCS)	Systolic Blood Pressure (SBP)	Respiratory Rate (RR)	Coded Value
13-15	>89	10-29	4
9-12	76-89	>29	3
6-8	50-75	6-9	2
4-5	1-49	1-5	1
3	0	0	0

RTS = 0.9368 GCS + 0.7326 SBP + 0.2908 RR

Values range from 0.00 to 7.84. The higher the RTS value, a higher probability for survival is expected. The values used for calculation are that obtained from the first recorded values in the emergency department.

Glasgow Coma Scale

The Glasgow Coma Scale provides a score in the range 3-15; patients with scores of 3-8 are usually said to be in a coma. The total score is the sum of the scores in three categories. For adults the scores are as follows:

Eye Opening Response	Spontaneous--open with blinking at baseline	4 points
	Opens to verbal command, speech, or shout	3 points
	Opens to pain, not applied to face	2 points
	None	1 point
Verbal Response	Oriented	5 points
	Confused conversation, but able to answer questions	4 points
	Inappropriate responses, words discernible	3 points
	Incomprehensible speech	2 points
	None	1 point
Motor Response	Obeys commands for movement	6 points
	Purposeful movement to painful stimulus	5 points
	Withdraws from pain	4 points
	Abnormal (spastic) flexion, decorticate posture	3 points
	Extensor (rigid) response, decerebrate posture	2 points
	None	1 point

APACHE II Score

The APACHE II (Acute Physiology and Chronic Health Evaluation II) model, published in 1985, was developed to simplify the original APACHE model and has become the most frequently used general mortality prediction model. APACHE II has been extensively validated, and despite being the oldest system, it still performs well. More recent versions (APACHE III and IV) have not been widely adopted. All the APACHE models are based on the most abnormal values registered during the first 24 h after ICU admission.

Min score = 0

Max score = 71

Increasing score is associated with increasing risk of hospital death.

The APACHE II Severity of Disease Classification System

Physiologic Variable	+4	+3	+2	+1	0	+1	+2	+3	+4
Temperature - rectal (°C)	≥41	39-40.9		38.5-38.9	36-38.4	34-35.9	32-33.9	30-31.9	≤29.9
Mean Arterial Pressure (mm Hg)	≥160	130-159	110-129		70-109		50-69		≤49
Heart Rate	≥180	140-179	110-139		70-109		55-69	40-54	≤39
Respiratory Rate (nonventilated or ventilated)	≥50	35-49		25-34	12-24	10-11	6-9		≤5
Oxygenation (mmHg) a. $FiO_2 > 0,5$ use $A\text{-}aDO_2$ b. $FiO_2 < 0,5$ use PaO_2	a ≥500	350-499	200-349		<200				
	b				> 70	61-70		55-60	<55
Arterial pH	≥7.7	7.6-7.69		7.5-7.59	7.33-7.49		7.25-7.32	7.15-7.24	<7.15
Serum Sodium (mmol/l)	≥180	160-179	155-159	150-154	130-149		120-129	111-119	≤110
Serum Potassium (mmol/l)	≥7	6-6.9		5.5-5.9	3.5-5.4	3-3.4	2.5-2.9		<2.5
Serum Creatinine (mg/dl, Double point score for acute renal failure)	≥3.5	2-3.4	1.5-1.9		0.6-1.4		<0.6		
Hematocrit (%)	≥60		50-59.9	46-49.9	30-45.9		20-29.9		<20
White Blood Count (in 1000/mm³)	≥40		20-39.9	15-19.9	3-14.9		1-2.9		<1
Glasgow-Coma-Scale (GCS)	Score = 15 minus actual GCS								
Serum HCO_3 (venous, mmol/l, use if no ABGs)	≥52	41-51.9		32-40.9	22-31.9		18-21.9	15-17.9	<15
A = Total Acute Physiology Score APS	Sum of the 12 individual variable points								

B = Age Points

≤44 years	0 points
45-54 years	2 points
55-64 years	3 points
65-74 years	5 points
≥75 years	6 points

C = Chronic Health Points

If the patient has a history of severe organ system insufficiency or is immunocompromised assign points as follows:

a. For nonoperative or emergency postoperative patients – 5 points

b. For elective postoperative patients – 2 points

APACHE II Score = Sum of A (APS points) + B (Age points) + C (Chronic Health points)

(From: Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. Crit Care Med 1985;13(10):818-29)

2.7 Sample size calculation

- For first specific objective: To determine the demographics pattern of patient admitted to TICU (gender, age, race, injury mechanism, type of injuries, primary team, initial GCS, injury severity score (ISS).

  Sample size needed from this objective is 106 based on the available data from the literature review. However, not all of the required data for sample size calculation for each of the independent variables were able to be obtained from the literature review. This sample size calculation is based on the available data using single proportion estimation calculations of Microsoft Excel.

  Factor: Age

  According to Malaysia National Trauma Database in 2009, the younger age group (15-34 years: 56.6%) was at the higher risk of major trauma to be admitted to ICU. The sample size required to determine the factor with probable outcome is 106 (95+10% dropout rate).

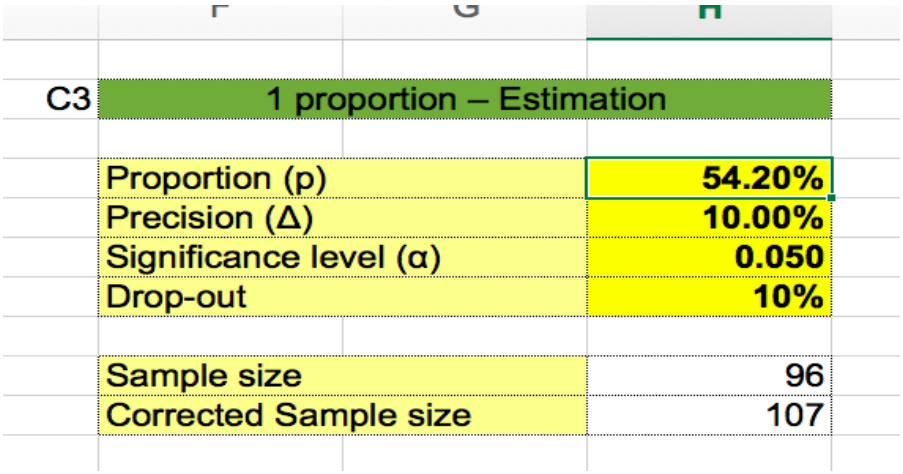
C3	1 proportion – Estimation
Proportion (p)	**56.60%**
Precision (Δ)	**10.00%**
Significance level (α)	**0.050**
Drop-out	**10%**
Sample size	95
Corrected Sample size	106

- For second specific objective: To determine the outcome of patient: blood transfusion, length of ICU stay, duration of mechanical ventilation, mortality, trauma related complications (rhabdomyolisis, AKI, fat/pulmonary embolism, sepsis)

  Sample size needed from this objective is 85 based on the available data from the literature review. However, not all of the required data for sample size calculation for each of the independent variables were able to be obtained from the literature review. This sample size calculation is based on the available data using single proportion estimation calculations of Microsoft Excel.

  Outcome: Mechanical ventilation

  According to Chalya et al, 54.2% of the patients who admitted to ICU required mechanical ventilation. The sample size required to determine associated factors with this outcome is 107 (96+10% dropout rate).



C3	1 proportion – Estimation	
	Proportion (p)	54.20%
	Precision (Δ)	10.00%
	Significance level (α)	0.050
	Drop-out	10%
	Sample size	96
	Corrected Sample size	107

- For third specific objective: To determine the demographic factors associated with patient outcome

No sample size calculation is needed for descriptive analysis.