SCORING SYSTEMS IN PEDIATRIC INTENSIVE CARE UNIT

Thesis

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Abstract

Background: Little is known of the exact causes of death and the impact of general risk factors that may complicate the course of critically ill patients. Scoring systems for use in ICU patients allow an assessment.

Objectives: Apply commonly used scores for assessment of illness severity and determine their relation to patient outcome. And identify the combination of factors capable of predicting patient's outcome.

Methods: This study included 231 patients were admitted to PICU of Cairo University Pediatric Hospital over one year. PRISM III, PIM2, PEMOD, PELOD, TISS and SOFA scores were obtained for every patient within the day of admission and patients were evaluated on follow up using SOFA score and TISS. Then each score parameter was evaluated separately.

Results: Significant positive correlations were found between PRISM III, PIM2, PELOD, PEMOD, SOFA and TISS on the day of admission and mortalities of PICU ($p<0.0001$). TISS and SOFA score had the highest discrimination ability (area under ROC curve: 0.81, 0.765 respectively). Also significant positive correlations were found between SOFA score and TISS scores on day 1, 3 and 7 and mortalities of PICU ($p<0.0001$). TISS had more ability of discrimination than SOFA score on day 1 (area under ROC curve 0.843, 0.787 respectively). Other factors that increase risk of mortality were longer length of stay, mechanical ventilation, vaso-active drugs and dialysis.

Conclusion: Scoring systems applied in our PICU had good discrimination ability. TISS was a good tool for following up patients. LOS, use of mechanical ventilation and inotropes were risk factors of mortality.

Key words: Scoring systems - Pediatric intensive care unit- Mortality rate- Critical care-illness severity- multiple organ dysfunction.

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List of Abbreviations

ACTH	Adrenocorticotropic hormone
ADH	anti-diuretic hormone
AIDS	acquired immune deficiency syndrome
APACHE	Acute Physiology and Chronic Health Evaluations
ARF	acute respiratory failure
ARDS	acute respiratory distress syndrome
ARF	Acute renal failure
ATN	acute tubular necrosis
BIS	bispectral index
BMT	bone marrow transplantation
BSIs	blood stream infections
CAUTI	Catheter-associated urinary tract
CDC	Centers for Disease Control and Prevention
CFU	colony-forming units
CHD	congenital heart disease
CHF	congestive heart failure
CMP	cardiomyopathy
CMM	Cancer Mortality Model
CNS	central nervous system
CONS	coaggulase negative staff
CP	Child–Pugh
CPA	Cardiopulmonary arrest
CPR	cardiopulmonary resuscitation
CRIB	Clinical Risk Index for Babies
CSEP	Clinically suspected sepsis
CSF	cerebrospinal fluid.
CVC	central venous catheter
CVP	central venous pressure
CVS	cardiovascular
DIC	disseminated intra-vascular coagulation
DKA	Diabetic keto-acidosis
DMD	Duchenne muscular dystrophy
DORA	Dynamic Objective Risk Assessment
DRGs	Diagnostic Related Groupings
DSN	Dialysis Surveillance Network
ECG	electrocardiogram
EEG	electroencephalograms

EENT	eye, ear, nose, and throat
ENT	Ear, Nose, & Throat
EtCO2	End-tidal CO2
GCS	Glasgow Coma Scale
GI	gastrointestinal
HAI	Health care associated infection
ICP	intracranial pressure
ICU	Intensive Care Unit
IOM	institute of medicine
LOS	length of stay
LRI	lower respiratory tract infections
MODS	Multiple organ dysfunction syndrome
MPM	Mortality Probability Models
NaSH	National Surveillance System for Healthcare Workers
NICU	neonatal ICU
MRSA	methicillin-resistant S aureus (MRSA)
NHSN	National Healthcare Safety Network
NMD	Neuromuscular disorders
NNIS	National Nosocomial Infection Surveillance System
PaCO2	arterial carbon dioxide pressure
PEMOD	PEdiatric Multiple Organ Dysfunction
PELOD	PEdiatric Logistic Organ Dysfunction
PIM	Pediatric Index of Mortality
PICANet	Pediatric Intensive Care Audit network
PICU	Pediatric intensive care unit
PNE	pneumonia
PO2	partial pressure of oxygen
PPS	Prospective Payment System
PRISM	Pediatric Risk of Mortality
PSI	Physiologic Stability Index
PVC	polyvinyl chloride
RIFLE	Risk, injury, failure, loss and end-stage kidney classification
ROC	receiver operating characteristic
S. aureus	Staphylococcus aureus.
SAPS	Simplified Acute Physiology Score
SENIC	Study of the Efficacy of Nosocomial Infection Control
SIADH	syndrome of inappropriate secretion of antidiuretic hormone
SIRS	systemic inflammatory response syndrome
SLOSR	standardized length of stay ratio
SMA	spinal muscular atrophy

SMR	standardized mortality ratio
SNAP	Score for Neonatal Acute Physiology
SOFA	Sepsis-related Organ Failure Assessment
SSI	surgical site infections
SST	skin and soft tissue
TcCO2	transcutaneous carbon dioxide tension
TcO2	transcutaneous oxygen tension
TISS	Therapeutic Intervention Scoring System
UTI	urinary tract infection
VAP	Ventilator-associated pneumonia

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Introduction

One pediatric population of special interest is critically ill children requiring intensive care services, since these children are at an increased risk of death ***(Lopez, 2006).***

In recent decades, intensive care medicine has developed into a highly specialized discipline covering several fields of medicine. Whereas the total number of hospital beds in the United States decreased by 26.4% from the year 1985 to 2000, intensive care unit (ICU) beds increased by 26.2% during the same period, underlining the high demand for intensive care medicine ***(Halpern, 2004).*** Mortality rates in the ICU strongly depend on the severity of illness and the patient population analyzed, and 6.4% to 40% of critically ill patients were reported to die ***(Azoulay 2003).***

Although patho-physiological processes and new treatment approaches are extensively analyzed in laboratory and clinical research, comparably less data are available on the causes of death, short- and long-term outcomes of critically ill patients, and associated risk factors ***(Arabi, 2004).***

Mostly, data on specific prognostic criteria for single diseases have been published ***(Bernieh, 2004).*** However, little is known of the exact causes of death and the impact of general risk factors that may uniformly complicate the course of critically ill patients irrespective of the underlying disease ***(Khouli, 2005).*** Knowledge of such general determinants of outcome in a critically ill patient population would not only help improve prognostic evaluation of ICU patients, but also indicate what therapy and research should focus on to improve the short and long term outcomes of critically ill patients ***(Chang, 2006).***

Scoring systems for use in ICU patients have been introduced and developed over the last 30 years. They allow an assessment of the severity of disease and provide an estimate of in-hospital mortality. This estimate is achieved by collating routinely measured data specific to a patient. Weighing is applied to each variable, and the sum of the weighed individual scores produces the severity score ***(Le Gall, 2005).***

Scoring systems such as the Pediatric Risk of Mortality (PRISM) score and Pediatric Index of Mortality (PIM) are widely used in pediatric intensive care. These are third generation scoring systems that allow assessment of the severity of illness and mortality risk adjustment in heterogeneous groups of patients in an objective manner, enabling conversion of these numbers into a numerical mortality risk based on logistic regression analysis ***(van Keulen, 2005).***

Aim of work:

This study was designed to:

- Describe the profile of patients admitted to PICU over one year in terms of underlying condition, system failure, as well as the supportive services provided.
- Apply commonly used scores for assessment of illness severity and determine their relation to patient outcome.
- To identify the combination of factors capable of predicting patient's outcome.

Review of literature

Historical background:

In 1854, Florence Nightingale left for the Crimean War, where triage was used to separate seriously wounded soldiers from the less-seriously wounded. It was reported that Nightingale reduced mortality from 40% to 2% on the battlefield. Although this was not the case, her experiences during the war formed the foundation for her later discovery of the importance of sanitary conditions in hospitals, a critical component of intensive care ***(Manni, 2007).***

In 1950, anesthesiologist Peter Safar established the concept of "Advanced Support of Life," keeping patients sedated and ventilated in an intensive care environment. Safar is considered to be the first practitioner of intensive-care medicine ***(Grossman et al, 2007).***

Intensive care dates from the polio epidemic in Copenhagen in 1952. Doctors reduced the 90% mortality in patients receiving respiratory support with the cuirass ventilator to 40% by a combination of manual positive pressure ventilation provided by medical students and by caring for patients in a specific area of the hospital instead of across different wards. Having an attendant continuously at the bedside improved the quality of care but increased the costs and, in some cases, death was merely delayed ***(Bennette et al, 2009).***

Bjørn Aage Ibsen established the first intensive care unit in Copenhagen in 1953 ***(Grossman et al, 2007).*** The first application of this