



## Save the patient a trip. Outcome difference between conservatively treated patients with traumatic brain injury in a nonspecialized intensive care unit vs a specialized neurosurgical intensive care unit in the Sultanate of Oman <sup>☆</sup>



Ammar M. Al-Kashmiri, MD, FRCP(C), FACEP <sup>a,\*</sup>, Sultan Z. Al-Shaqsi, MBChB, PhD <sup>b</sup>,  
Adil S. Al-Kharusi, MD <sup>c</sup>, Laila A. Al-Tamimi, RN <sup>d</sup>

<sup>a</sup> Emergency Department, Khoula Hospital Muscat, Oman

<sup>b</sup> Department of Plastic and Reconstructive Surgery, Khoula Hospital Muscat, Oman

<sup>c</sup> Intensive Care Department, Khoula Hospital Muscat, Oman

<sup>d</sup> Intensive Care Department, Nizwa Hospital, Nizwa, Oman

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### ABSTRACT

Traumatic brain injury (TBI) continues to be the main cause of death among trauma patients. Accurate diagnosis and timely surgical interventions are critical steps in reducing the mortality from this disease. For patients who have no surgically reversible head injury pathology, the decision to transfer to a dedicated neurosurgical unit is usually controversial.

**Objective:** To compare the outcome of patients with severe TBI treated conservatively in a specialized neurosurgical intensive care unit (ICU) and those treated conservatively at a general ICU in the Sultanate of Oman.

**Design:** Retrospective cohort study.

**Methods:** This is a retrospective study of patients with severe TBI admitted to Khoula Hospital ICU (specialized neurosurgical ICU) and Nizwa Hospital ICU (general ICU) in Oman in 2013. Surgically treated patients were excluded. Data extracted included demographics, injury details, interventions, and outcomes. The outcome variables included mortality, length of stay, length of ICU days, and ventilated days.

**Results:** There were 100 patients with severe TBI treated conservatively at Khoula Hospital compared with 74 patients at Nizwa Hospital. Basic demographics were similar between the 2 groups. No significant difference was found in mortality, length of stay, ICU days, and ventilation days.

**Conclusion:** There is no difference in outcome between patients with TBI treated conservatively in a specialized neurosurgical ICU and those treated in a general nonspecialized ICU in Oman in 2013. Therefore, unless neurosurgical intervention is warranted or expected, patients with TBI may be managed in a general ICU, saving the risk and expense of a transfer to a specialized neurosurgical ICU.

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### 1. Introduction

Traumatic brain injury (TBI) is a major public health problem that contributes to significant morbidity and mortality worldwide. About one third of trauma-related deaths are attributed to severe TBI [1]. Furthermore, TBI results in disabilities in survivors. Around 43% of patients with TBI discharged after acute hospitalizations experience long-term disability [2]. According to the US Center of Disease Control, TBI has resulted in a greater number of years of productive life lost than either heart disease or stroke. The magnitude of the problem is on the rise worldwide, owing to an increase in motor vehicle use and the resultant

traffic crashes [3]. This is particularly prevalent in low- and middle-income countries [4]. The management of severe TBI has evolved over the past decade, and treatment is now broadly based on evidence-based guidelines [5]. Furthermore, there is evidence that adhering to medical guidelines in the management of such injuries is associated with improved clinical outcomes [6–8]. The main objective in TBI management is prevention of secondary insults by minimizing intracranial hypertension and preservation of adequate cerebral perfusion pressure, and optimization of cerebral oxygenation [9]. Therefore, monitoring and treatment of raised intracranial pressure in an intensive care setting is paramount for maintaining an adequate cerebral blood supply and oxygen delivery, as well as early detection for need of neurosurgical intervention.

The Sultanate of Oman has seen rapid modernization, and the pattern of injury likely resembles that of other developing nations with regard to the burden of TBI. There are 2 specialized neurosurgical care centers in the Sultanate of Oman. In practice, a question often arises

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\* Corresponding author at: Emergency Department, Khoula Hospital, PO Box 1720, Ruwi, Oman, P.C. 112.

E-mail address: [ammkar.k@moh.gov.om](mailto:ammkar.k@moh.gov.om) (A.M. Al-Kashmiri).

whether the care of patients with severe TBI is best provided in the specialized center. The logistics of transferring injured patients from remote geographical locations to this center as well as the increased demand on its intensive care unit (ICU) beds frequently makes this decision complex. This study aims to compare the outcome of patients conservatively treated in a nonspecialized ICU of a regional hospital under the care of anesthesiologists and general surgeons—who are not certified intensivists—to those treated in the ICU of the neurosurgical center where care is jointly provided by intensivists and neurosurgeons. The aim of this study is to be able to guide policymaking and transfer decisions. Similar studies have been conducted elsewhere [10,11], but we believe that this study is unique because it is conducted in a country with a complex geography and a different health system organization.

## 2. Materials and methods

This is a retrospective review of patients admitted with TBI to 2 ICUs in the Sultanate of Oman in 2013, where all consecutive patients treated in both centers were included. Nizwa Hospital is a secondary-level care regional hospital for Al-Dakalyia governorate in Oman. It serves around 300 000 people. The hospital has an 8-bed modern ICU that is staffed by anesthesiologists. The ICU provides care to both medical and surgical critically ill patients. The hospital has no neurosurgical services, and therefore, patients who require neurosurgical interventions are transferred to the National Trauma Centre (Khoulā Hospital). Khoulā Hospital is located in Muscat Governorate. It has specialized neurosurgical services and a state-of-the-art ICU. Patients with TBI admitted to Khoulā Hospital are jointly cared for by certified intensivists and specialist neurosurgeons. There was no specific management protocol followed, and patients were treated on the basis of their symptoms, for example, using mannitol to reduce high intracerebral pressure (ICP) and anticonvulsants for seizures. They did not undergo any surgical intervention. In Nizwa Hospital, patients were monitored for deterioration by serial examinations, and in Khoulā, by ICP monitoring.

This study collected data from both Nizwa ICU and Khoulā ICU about all patients with TBI who were conservatively treated in 2013. The exclusion criteria included all surgically treated patients from both centers, and patients transferred from Nizwa to Khoulā were excluded if they have surgical intervention. Medical records were reviewed, and demographic, clinical status, management, and outcome variable were collected. Initial pathology as reported on the initial computed tomographic (CT) scan was also collected. In-hospital mortality rate is the primary outcome recorded in this study. Secondary outcomes included length of hospital stay, ICU stay, and ventilated days. *Deterioration* was defined as a drop in Glasgow Coma Scale (GCS) score or a change in hemodynamic stability or developing a general health complication excluding death. Two collectors directly entered data into a prepopulated SPSS datasheet (one at Khoulā hospital ICU and the other at Nizwa hospital ICU).

Data were analyzed using the SPSS program. First, the study presents a descriptive analysis of all the variables collected. In order to assess the significance of differences between the 2 ICU centers in the variables collected, a series of  $\chi^2$  tests and the Fisher exact tests are used where appropriate. Furthermore, nominal regression analysis was used to assess the significance in outcome differences. The Statistical Package for Social Sciences (SPSS) software (SPSS Statistics 22.1, for Windows, Armonk, New York) was used in the data analysis.

The Ministry of Health's ethics committee approved the study.

## 3. Results

During the study period, there were 74 patients admitted to Nizwa Hospital ICU with TBI and treated conservatively. On the other hand, there were 100 patients admitted to Khoulā Hospital neuro-ICU with TBI and treated conservatively. Table 1 shows the characteristics and demographics of the 2 groups of patients reviewed. The mean age of patients in Nizwa was 29.3 and 32.4 years among Khoulā patients.

**Table 1**

Characteristics of patients with TBI admitted to Nizwa ICU vs Khoulā ICU

Variable	Nizwa (n = 74)	Khoulā (n = 100)	P
Demographic information			
Sex			
Male	66 (89.2%)	78 (78.0%)	.07
Female	8 (10.8%)	22 (22.0%)	
Age, mean (range)	29.3 (1–65) y	32.4 y (8 mo–88 y)	.80
Injury information			
Time of event			
6 AM–2 PM	45 (60.8%)	36 (36.0%)	.03
2 PM–10 PM	20 (27.0%)	56 (56.0%)	
10 PM–6 AM	9 (12.2%)	8 (8.0%)	
Transport			
Ambulance	67 (90.5%)	100 (100%)	<.01
Private	7 (9.5%)	0	
Median GCS	5	3	.01
Median motor GCS	1	1	.1
Injury Severity Score, mean (SD)	30 (15)	30 (18)	.1
Hemodynamic instability	6 (8.1%)	5 (5.0%)	.5
Pupils			
PEARLA	39 (52.7%)	59 (59.0%)	.6
Constricted	8 (10.8%)	8 (8.0%)	
Fixed dilated	27 (36.5%)	33 (33.0%)	
Airway			
Endotracheal	69 (93.2%)	74 (74.0%)	.01
Spontaneous	5 (6.8%)	26 (26.0%)	
Use of inotrope	16 (21.6%)	23 (23.0%)	.9
Time to 1st CT scan (h), median (range)	3 (1–20)	3.5 (2–6)	.4
Pathology of 1st CT scan			
SDH	20 (27.0%)	37 (37.0%)	.03
EDH	11 (14.9%)	36 (36.0%)	
Contusion	12 (16.2%)	32 (32.0%)	
SAH	40 (54.1%)	22 (22.0%)	
GCO	32 (43.2%)	18 (18.0%)	
CMF	9 (12.2%)	8 (8.0%)	
DAI	6 (1.0%)	4 (4.0%)	
ICP monitoring	0	21 (21.0%)	<.01

GCO indicates global cerebral edema; CMF, craniomaxillofacial fracture; DAI, diffuse axonal injury; PERLA, pupils equal and reactive to light and accommodation.

Most patients (60.8%) were admitted to Nizwa ICU during the morning hours (6 AM–2 PM) compared with 56% of Khoulā patients who were admitted during the afternoon shift (2 PM–10 PM). All patients admitted to Khoulā Hospital were transferred by ambulance services compared with 90.5% of Nizwa patients. The median GCS score was significantly lower in Khoulā Hospital patients compared with that of Nizwa patients (3 vs 5,  $P = .01$ ). Nevertheless, there was no difference between the 2 groups in the motor component of GCS, overall Injury Severity Score, or hemodynamic instability.

On arrival to ICU, the proportion of patients intubated was higher in the Nizwa group than in the Khoulā group (93.2% vs 74%,  $P = .01$ ). There was no significant difference in the time from admission to first CT scan of the head among the 2 groups studied. Subarachnoid hemorrhage was the most common pathology among the Nizwa group (54.1%). Subdural hematoma was the most common pathology reported from Khoulā Hospital (37%). None of Nizwa Hospital patients received ICP monitoring compared with 21% of Khoulā patients who had ICP monitoring.

Table 2 shows the relative risk (RR) of several outcome measures between Nizwa patients and Khoulā patients, as calculated using regression analysis model to account for potential confounders presented in the first table. Nizwa patients stayed shorter in the ICU and had less mechanical ventilation days and shorter overall hospital stay compared with Khoulā Hospital. Nevertheless, in-hospital mortality rate was higher in Nizwa (23%) compared with Khoulā (17%; RR, 1.35). However, this trend did not reach statistical significance. When mortality is compared by pathology on initial CT, patients with subarachnoid hemorrhage (SAH) were 6 times more likely to die if admitted to Nizwa ICU compared with Khoulā ICU. Furthermore, patients with TBI admitted to Nizwa ICU were significantly more to be subjectively “functionally worse” on discharge than those admitted to Khoulā neuro-ICU.

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