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TANAFFOS

The Prevalence and Outcome of Intensive Care Unit Acquired Weakness (ICUAW)

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Background: Intensive care unit acquired weakness (ICUAW) is a known complication in ICU patients, especially in those with severe underlying diseases. The cause and pathogenesis of ICUAW are still unknown. This study examined the incidence rate of ICUAW in intensive care units (ICUs) of the Masih-Daneshvari Hospital.

Materials and Methods: This descriptive-comparative study was conducted on 160 patients admitted in the ICUs, including an acute respiratory infectious ICU (TB-ICU) and medical ICU. The total number of patients was 80 in each of the ICUs. Demographic information was obtained from the patients after the initial examination and Medical Research Council (MRC) score was done on daily basis. EMG was performed on the 2nd and 8th days of the admission. ICUAW diagnosis was used in cases with MRC scores under 48.

Results: Among the patients, 68.6% were male and the mean age was 59.13±18. 68 years. The final outcomes were 48.4% mortality and 51.6% discharge, which were 41% and 59% in the TB-ICU and 56.7% and 43.3% in the medical ICU, respectively. By defining electromyography as the gold standard, the sensitivity and specificity of ICUAW diagnosis based on the MRC score definition were about 70% and 83%, respectively. The comparison ICUAW patients in the two ICUs in terms of mortality showed no significant difference between them.

Conclusion: It is concluded that nearly half of ICU-admitted patients develop ICUAW that causes a higher mortality rate. Therefore, new plans should be developed to reduce the rate of ICUAW and subsequent death, as well as other possible morbidities.

Key words: ICUAW; Incidence; Survival; Electromyography; Medical research council muscle score

INTRODUCTION

Intensive care unit acquired weakness (ICUAW) is a known complication in ICU patients, especially in those with severe underlying diseases with a prevalence range from 26 to 56 percent (1). Some contributing risk factors include sepsis (2), use of vasopressors (3), and hyperglycemia (4). This complication causes severe proximal and respiratory muscle weakness and, consequently, leads to prolonged hospitalization in ICUs and difficult weaning from mechanical ventilation (5). This, in turn, results in a sharp rise in the treatment system cost and worsened prognosis in patients. The cause and pathogenesis of ICUAW are still unknown (6-8). ICUAW is a clinical dilemma diagnosed by electrophysiology and newer diagnostic tests including muscle ultrasound. Hence, further assessment is required in this field. It should be noted that while some patients with ICUAW

experience full improvement, the improvement may be slow and incomplete in some other patients, which affects the quality of life in them (9-12). Since few studies have been conducted in this field in Iran, the issue becomes more significant in healthcare facilities such as our tertiary healthcare facility, to which patients with both internal and infectious diseases are admitted. Such studies are required to develop efficient plans to prevent ICUAW and its consequences (13-25). This study assessed the incidence rate of ICUAW in ICUs of the Masih Daneshvari Hospital.

MATERIALS AND METHODS

In this descriptive-comparative study, 160 consecutive patients admitted to the ICUs were enrolled. Then, demographic information was obtained from the patients after the initial examination and diagnosis of ICUAW. The inclusion criteria were non-surgical ICU admission, ICU stay over 48 hours, presence of muscle weakness, and completeness of data for patients. The exclusion criteria were neuromuscular disease before admission, ICU-sepsis, thyroid dysfunction, hypomagnesemia, other metabolic disorders, diseases accompanying with respiratory muscle weakness such as acute respiratory distress syndrome (ARDS), and being discharged or deceased during the first 48 hours after admission. This study was approved by a local ethical committee.

The total number of patients was 80 in each of the ICUs. The gold-standard diagnostic test was electromyography (EMG). Conscious patients were initially assessed using the Medical Research Council (MRC) score (Table 1). EMG was performed by a blind specialist on the 2nd and 8th days of the admission according to the universal-accepted definitions with a single device (5000 Q pro-Negar Andishegan Company, Iran) and a blind observer (6,9,26-28). MRC score was done on a daily basis by an expert physiotherapist. ICUAW was used in cases with sum scores under 48 and was not applicable in cases weaning off a ventilator. EMG analysis was performed and according to the results in patients with established ICUAW, physiotherapy was performed alongside therapeutic interventions. The final outcomes were recorded and compared among those with and without ICUAW.

The data was analyzed using SPSS version 18.0. The utilized tests were Kolmogorov-Smirnov, Mann-Whitney-U, Pearson's chi-square, Fisher's exact, repeated-measures ANOVA, and Friedman tests. The significance level was considered less than 0.05.

RESULTS

Total prevalence rates of ICUAW were 44.9% and 42.5% according to MRC score and EMG, respectively. The contributing rate was 42.1% and 47.5% in the TB-ICU and the medical ICU by MRC score (P>0.05) and 42.1% and 47.5% in the TB-ICU and the medical ICU by EMG (P>0.05), respectively. The positive status for spontaneous electrical activity (SEA) was present in 60.9% of the patients. Moreover, 26.6% and 36.3% of the patients in the TB-ICU and the medical ICU were female, respectively (P>0.05). As shown in table 2, age (P=0.040) and sural SNAP amplitude at 2nd day (p=0.028) were significantly higher among the patients in the medical ICU compared with those in the TB-ICU. The other variables were not different between the ICUs (P>0.05). The background disease was not assessed as an essential variable because patients with disorders accompanied with respiratory muscular weakness such as ARDS and pneumonia were excluded. The total mortality rate was 48.7% including 41% and 56.3% in in the TB-ICU and the medical ICU, respectively, with significant difference (P>0.05).

As shown in table 3, the total mortality rate in patients with and without ICUAW was 68% and 41%, respectively, with significant difference (P=0.036). As shown in table 4, in comparison with EMG as the gold standard, the MRC score sensitivity and specificity were 70% and 83%, respectively.

Figures 1, 2, and 3 show that the reduction rate was higher for peroneal CMAP amplitude than for median CMAP amplitude and sural SNAP amplitude by up to 50%. However, peroneal CMAP amplitude did not

decrease below the cut-off point. It was expected that the results of additional EMG done after 2 weeks would show a further decrease, even under the cut-off point. The mortality rate in the SEA-positive patients was 61.5% including 61.1% and 61.9% among the patients in the TB-ICU and the medical ICU, respectively (P=0.769). The positive status for SEA was not related to mortality (P>0.05). As demonstrated in table 5, the mean sural SNAP amplitude was significantly different among the patients in the ICUs and in total according to the SEA result (P<0.05).

Table 1. Reference values generated in the KU Leuven electrophysiology laboratory, stimulation and recording sites for CMAP and SNAP amplitudes

	Nerve	Cut-off	Location of stimulation	Location of recording
CMAP	Median	< 6000 µV	Middle anterior wrist and elbow fold	M abductor pollicis brevis
	Ulnar	< 4500 µV	Ulnar anterior wrist and medial epicondyle	M abductor digiti minimi
	Peroneal	< 1000 µV	Anterior ankle and fibular head	M extensor digitorum brevis
	Tibial	< 2500 µV	Inner ankle and knee fold	M flexor hallucis brevis
SNAP	Median	< 4 µV	Middle anterior wrist	Palmar index finger
	Radial	< 4 µV	Lateral edge of radius bone	Web space between digits I & II
	Sural	< 4 µV	Lateral of Achilles tendon	At lateral malleolus

CMAP amplitude: compound muscle action potential, SNAP amplitude: sensory nerve action potential

SNAPs amplitude were measured antidromically with 14 cm distance between stimulation and recording site

Reference: Greet Hermans 2012.

Table 2. Frequency distribution of variables across the TB and Medical ICUs

Items	ICU type	Mean	SD	P value
Age	TB ICU	54.9	19.8	0.040
	MICU	63.3	16.7	
	Total	59.1	18.7	
Median CMAP amplitude admit	TB ICU	7069.4	1583.5	0.228
	MICU	7404.6	1536.4	
	Total	7240.9	1562.4	
Peroneal CMAP amplitude admit	TB ICU	3129.5	1740.3	0.571
	MICU	3326.2	2112.0	
	Total	3231.0	1935.8	
Sural SNAP amplitude admit	TB ICU	5.7	1.2	0.028
	MICU	6.3	1.7	
	Total	6.0	1.5	
Median CMAP amplitude 8 day	TB ICU	5451.7	1762.8	0.074
	MICU	6235.0	1777.7	
	Total	5905.8	1801.1	
Peroneal CMAP amplitude 8 day	TB ICU	1548.1	1896.8	0.378
	MICU	2035.0	2382.7	
	Total	1838.8	2197.7	
Sural SNAP amplitude 8 day	TB ICU	3.3	1.6	0.192
	MICU	4.0	2.4	
	Total	3.7	2.1	

Table 3. Mortality rate among those with and without ICUAW

ICUAW Diagnosis	Criteria	ICU TAPE	Mortality	P value
Yes	MRC score admission	TB ICU	62.5%	0.439
		MICU	73.7%	
		Total	68.6	
	EMG	TB ICU	65.2%	0.769
		MICU	71.0%	
		Total	68.5	
No		Total	41%	0.036

Table 4. Sensitivity and specificity of MRC score

Test	Index	TB ICU	MICU	Total
MRC score	Prevalence	42.1	47.5	44.9
	Sensitivity	0.696	0.677	0.685
	Specificity	0.816	0.853	0.833
	Positive predictive value	0.696	0.808	0.755
	Negative predictive value	0.816	0.744	0.779
EMG	Prevalence	37.7	47.7	42.5

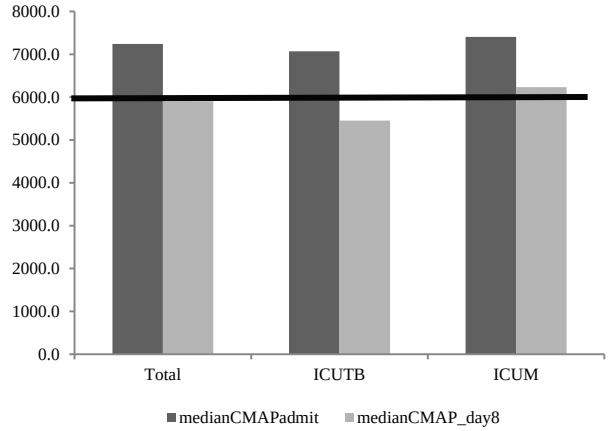

Figure 1. Median CMAP amplitude alterations at first and after 8 days

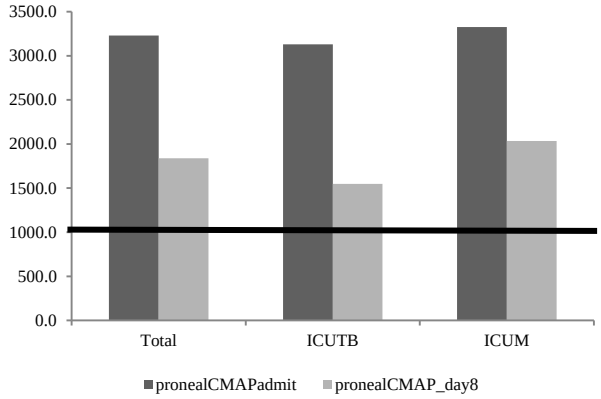

Figure 2. Peroneal CMAP amplitude alterations at first and after 8 days

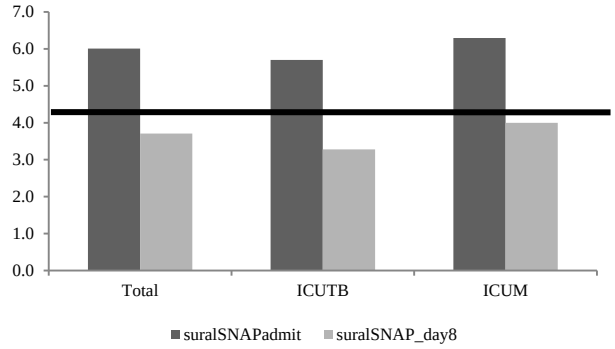

Figure 3. Sural SNAP amplitude alterations at first and after 8 days

Table 5. Mean Sural SNAP amplitude according to SEA status

ICU-Type	SEA=yes	SEA=no	P value
TB ICU	5.3±0.84	6.2±1.1	0.029
MICU	5.6±0.97	6.7±1.4	0.007
Total	5.5±0.9	6.5±1.32	<0.001

DISCUSSION

In this comparative study that was performed for the first time in Iran, the prevalence and outcome of ICUMW were determined among 160 patients admitted to ICUs of the Masih-Daneshvari Hospital, including a TB-ICU and a medical ICU. Total prevalence rates of ICUAW were 44.9% and 42.5% according to MRC score and EMG, respectively. The contributing rate was 42.1% and 47.5% in the TB-ICU and the medical ICU by MRC score (P>0.05) and 42.1% and 47.5% in the TB-ICU and the medical ICU by EMG (P>0.05), respectively. The study by Zorowitz (10) revealed that the prevalence rate of ICUAW ranged from 25 to 100 percent. This range includes the obtained rates in our study.

Ali et al. (7) reported the prevalence rate of 26 to 60 percent for ICUAW in patients with mechanical ventilation minimally for five to seven days, which is in congruence with our results. On the other hand, Bercker et al. (12) reported that the rate of ICUAW was 60 percent among ARDS patients accompanied with an increased mortality rate. They recommended further definite monitoring for ICUAW in ARDS patients. However, in our study, patients with disorders accompanied with respiratory muscle weakness were excluded to decrease the effects of

confounding variables. Moreover, since the current study was a pilot study on Iranian ICU patients, some variables including ventilator use, biochemical laboratory tests, and hospital stay were not assessed. Further, different diseases such as sepsis and hypoglycemia were not excluded to determine a definite frequency rate.

In the current survey, the majority of the patients (13-25) were male, as shown in other studies. The mean age in our study was 59 years, which is in congruence with other studies (15-20). However, mortality rates in other studies were lower than the rate of 48.7 percent obtained in our study (17-21). The association between mortality and ICUAW in our study demonstrated the need for further attention to ICUAW in critically ill patients. We found a faster rate of peroneal CMAP amplitude decrease compared to other neural locations. However, other studies did not report differences in this area (20-24).

According to the study's results, it may be concluded that nearly half of ICU-admitted patients develop ICUAW that results in a higher mortality rate. Accordingly, further plans should be developed to reduce the rate of ICUAW, subsequent death, and other possible morbidities. However, further studies with larger sample size are required to obtain more definite results and assess the trend of the problem in upcoming years.

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