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The Relationship between APACHE II Score and Mortality Among Patients with Stroke

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ABSTRACT

Valid indices and optimal models in predicting mortality rates among patients hospitalized in the emergency department have attracted much attention due to the wide use of mortality prediction instruments and the differences in the prediction result and hospitalization outcome for patients with stroke with disease severity tools. The present study aims to determine the relationship between APACHE II mean score and mortality among patients with stroke admitted to the emergency department in Shohadaye Ashayer Hospital in 2022. To conduct this prospective descriptive cross-sectional study, the information related to 273 patients with stroke admitted to the emergency department of the specialized neurology center in Shohadaye Ashayer Hospital in Khorramabad was utilized non-randomly, sequentially, and conveniently by applying the data collection tools during 2022. Demographic data, laboratory values, vital signs, and hospitalization outcomes in the emergency department during the first 24 hours were employed to calculate the APACHE II score. Based on univariate logistic regression model analysis, a significant relationship was observed between the APACHE II score with mortality among patients with stroke (P<0.001). In other words, the APACHE II predicted the mortality rate among patients with stroke accurately. The results revealed that the APACHE II accurately predicts the mortality rate and prioritizes patients with stroke for allocating treatment resources.

Keywords: Stroke; APACHE II; Emergency Department; Mortality

Introduction

Stroke is regarded as the second leading reason for mortality and the first critical cause of disability in the world after ischemic heart disease [1]. The American Stroke Association presented a new definition for stroke during the 21st century, which involves clinical and histological criteria. The proposed definition, which is broader, includes any acute objective and clinical event of permanent cell death in the brain, spinal cord, or retina [2].

In Iran, 139 people per 100,000 experience a new stroke annually, which is higher than that in most Western countries [3]. The clinical manifestations of stroke are highly diverse due to the complex anatomy of the brain and cerebrovascular system [4]. About one-third of patients experience permanent disability after stroke [5], which accounts for 62.7 million age-adjusted disabilities worldwide [6].

The incidence of stroke increases with age, with two-thirds of cases occurring among people over 65 years old. In addition, stroke is more common among men and blacks [7]. Risk factors for stroke include systolic or diastolic hypertension, hypercholesterolemia, smoking,

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excessive alcohol consumption, and use of oral contraceptives [8].

Patients with stroke are diagnosed based on the neurological signs and symptoms, which vary depending on the location and extent of the injury. A stroke usually leads to hemiplegia (paralysis in one half of the body) on the opposite side of the injury, and the patient may experience other complications, such as swallowing and cognitive disorders, as well as sensory, psychological, and emotional problems. The most common symptoms of stroke include hemiplegia (paralysis in one half of the body), weakness in the facial muscles, difficulty speaking, sudden headache, and loss of consciousness [9].

It is worth noting that ischemic (occlusive) and hemorrhagic complications are regarded as the main reasons for stroke. Ischemic stroke occurs when blood flow to the brain is interrupted by a blood clot, which accounts for 85% of all strokes. The blockage can occur in or around the brain. In addition, blood clots can travel to the brain from other parts of the body through the bloodstream. Ischemic stroke occurs due to several reasons, such as fatty deposits, plaque buildup in the arteries of the neck, or heart conditions that lead to blood clots [10].

As indicated, the hemorrhagic complication is considered another major reason for strokes, in which the blood vessels that supply blood to the brain tissue rupture, leading to a hemorrhagic stroke. In this condition, the blood entering the brain damages brain cells and reduces blood flow to the area [11]. Hemorrhagic strokes are usually more serious than ischemic ones, so 30-50% of people who suffer from this type of stroke die. High blood pressure, vascular aneurysms, head trauma, and excessive alcohol or drug use are among the main reasons for hemorrhagic strokes [12].

Valid indices and optimal models in predicting mortality rates among the patients hospitalized in the emergency department have attracted much attention due to the wide use of mortality prediction instruments in the emergency department and the difference in the prediction result and hospitalization outcome for patients with stroke with disease severity tools. This study seeks to determine the relationship between APACHE II mean score and mortality among patients with stroke admitted to the emergency department in Shohadaye Ashayer Hospital.

Materials and Methods

The present study is part of descriptive-cross-sectional research with a prospective and longitudinal method. The population included all patients admitted to the emergency department in Shohada-ye Ashayer Hospital in Khorramabad with a stroke diagnosis in 2022. The data were collected in person at the patient's bedside during the first 24 hours of admission to the emergency department after obtaining the code of ethics with the ID IR.LUMS.REC.1401.088 and other legal permits. To this aim, a data recording form completed by the researcher and his associate (emergency medicine specialist) was used. Notably, the emergency medicine specialist approved the accuracy of the patients' neurological examinations and data collection methods. The data were compiled in two sections: an interview, history, and examination of the patients based on the instruments available in the form above, including demographic information and the APACHEII.

Calculating the APACHE II

The APACHE II contains three parts as follows.

1. The acute physiology score includes 12 parameters. The value of each is related to the first 24 hours of hospitalization and ranges from 0 to 4 points. The score was 0 when no value was reported for a parameter. In addition, the worst value was included in the instrument when multiple values were defined for a variable. Temperature, mean arterial pressure, heart and respiratory rates, as well as serum sodium and potassium, white blood cell count, hematocrit, creatinine, glucose, and values of arterial gases (PH, PO_2, PCO_2, FIO_2, and HCO_3) were recorded here. In addition, eye, verbal, and motor responses were

examined in the section designed for determining the level of consciousness.

2. The patient's age is scored here. The patient achieves a score of 0 when he/she is under or equal to 44 years old. In addition, the patient obtains a score of 2 when he/she is between 45-54 years old. Further, the patient receives a score of 3 when he/she is between 55-64 years old. Furthermore, the patient achieves a score of 5 when he/she is between 65-74 years old. Finally, the patient obtains a score of 6 when he/she is above or equal to 75 years old.

3. Chronic diseases are recorded here. The patient receives a score of 5 when he/she has proven cirrhosis, severe chronic obstructive pulmonary disease, end-stage chronic heart failure, chronic dialysis, and immunodeficiencies such as leukemia, radiotherapy, chemotherapy, acquired immunodeficiency syndrome, long-term high-dose steroid therapy, and pulmonary hypertension candidate for emergency surgery. In addition, the patient achieves a score of 2 when he/she undergoes elective surgery.

Finally, the sum of the scores in the abovementioned sections (0-71) is considered the instrument's overall score. A high score increases the probability of mortality.

STATA v.16 was utilized to analyze the data. Central and dispersion indices, including mean, standard deviation (SD), median, and interquartile range, were applied to describe quantitative data in terms of distribution. In addition, relative and cumulative frequency indices were employed for qualitative data. Finally, a univariate logistic regression model was used to measure the relationship between the criteria above and patient survival.

Results

As indicated in Table 1, 53% of patients are female, 60% are over 65, and 56% are discharged. In addition, 45% of patients suffered from underlying hypertension. Further, 70% of patients experienced a delay of more than 4.5 hours from symptom onset to emergency department presentation, and 64% were transported to this department by emergency medical services (EMS). Ischemic was considered the most common type of stroke (81%), with the most common involvement being on the right side (41%).

Table 1: Frequency distribution among patients in terms of health, disease, and demographic variables

Demographic variable			N (%).	Outcome	
				Death	Discharge
Gender	Male		128(47%)	40(31%)	88(69%)
	Female		145(53%)	41(28%)	104(72%)
Age	65 years≥		108(40%)	8(7%)	100(93%)
	65 years<		165(60%)	72(44%)	93(56%)
Underlying disease	Diabetes		49(18%)	4(8%)	42(92%)
	Hypertension		118(45%)	41(35%)	77(65%)
	Diabetes + Hypertension		73(26%)	27(37%)	46(63%)
	Other cases		33(11%)	8(24%)	20(76%)
Time of symptom onset	4.5 hours ≥		82(30%)	26(32%)	56(68%)
	4.5 hours <		191(70%)	54(28%)	137(72%)
Method of transporting to the ED	Private/public vehicle		99(36%)	11(11%)	88(89%)
	EMS		174(64%)	70(40%)	104(60%)
Type of stroke	Ischemic	Right	109(41%)	28(24%)	81(76%)
		Left	106(40%)	27(25%)	79(75%)
	Haemorrhagic	Right	31(10%)	20(69%)	11(31%)
		Left	27(9%)	14(55%)	13(45%)

Table 2- Relationship between APACHE II score and mortality based on univariate logistic regression

Variable	Odds ratio	P-Value	Parent statistics	95% CI
APACHE II	67.1	<0.001	15.181	1.45-1.91

As shown in Table 2, a significant relationship is reported between the APACHE II score and the mortality rate (P<0.001). The odds ratio statistic was used to determine the effect of increasing the values of the independent variable on the probability of mortality. Based on the results, every one-unit increase in the APACHE II score raises the probability of mortality by 1.67 times (OR=1.67, 95% CI: 1.45-1.91).

Discussion

The present study assesses the relationship between the APACHE II mean score and survival among patients with stroke. To this aim, the mean (SD) of the corresponding score was determined to be 60.12 (37.8) after evaluating the APACHE II. Zhao et al. argued that the mean (SD) among the patients who survived and died from acute cerebral hemorrhage was 10.24 (5.73) and 19.18 (6.44), respectively, which is in line with the results presented here [13]. Based on the results, an increase in the APACHE II score raises the probability of predicting mortality among patients with stroke.

Many studies have been conducted in different countries to examine the usefulness of the instruments mentioned above, leading to different results [30]. In addition, Sungono et al. claimed that an increase in the APACHE II score raises the risk of mortality among the patients admitted to ICU [14]. Further, Zhao et al. reported that a significant relationship was observed between a higher score on the APACHE II and a higher probability of mortality as well as a higher rate of short- and long-term complications among patients with cerebral hemorrhage [13]. Furthermore, Tian et al. proposed the APACHE II score as an optimal instrument to predict survival among the patients admitted to the ICU [15]. In another study, Hosseini and Ramezani presented the APACHE II score as a useful instrument to predict mortality among patients admitted to the ICU [16]. Norouzi et al. compared the APACHE II and SAPS II scores to predict mortality rates among the patients admitted to the ICU. The results indicated that an increase in the APACHE II score raised the probability of mortality. In addition, the APACHE II score predicted the probability of mortality better than the SAPS II score [17]. The results reported by Norouzi are consistent with those obtained here despite the difference in the population. Further, Bahrami et al. investigated the abovementioned instruments in Bu Ali and Shahid Rajaei Hospitals in Qazvin, reporting a significant difference between the actual mortality and that calculated utilizing the APACHE II. The accuracy of the APACHE II in predicting mortality rate was confirmed [18]. The results in the studies above are congruent with those achieved here.

Many studies have been conducted on ICU patients' survival in addition to the abovementioned cases, representing a significant relationship between survival prediction instruments and mortality rates. However, the instruments above reported the predicted mortality rates lower than those in other studies [19]. Bahtouee et al. focused on the diagnostic power of APACHE II to predict the survival of patients in the ICUs, asserting that the actual mortality rate was significantly higher than the predicted one [20]. In addition, Kim et al. studied the diagnostic power of APACHE II to predict the survival of patients in the ICU and Department of Surgery, declaring that the predicted mortality rate was significantly lower than the actual one [21]. The results reported by the abovementioned studies are inconsistent with those presented here, which can be attributed to the worse

condition of patients admitted to the ICU, higher probability of mortality than expected, or even lower quality of medical care and increased mortality among the patients. Thus, an increase in the APACHE II score decreased the probability of survival among patients with stroke.

Conclusion

The results indicated that the APACHE II accurately predicts mortality and prioritizes among patients with stroke for allocating treatment resources. The APACHE II survival prediction instrument is designed to predict the survival of patients admitted to the ICU. However, this study was conducted to predict patient survival during the first 24 hours of admission to the emergency department. The APACHE II can be applied for better clinical decision-making when it benefits from high accuracy in patients with stroke ' acute and emergency stages.

Conflict of interests

The authors have no financial interest related to this article

References

1. Walelgn N, Abyu GY, Seyoum Y, Habtegiorgis SD, Birhanu MY. The survival status and predictors of mortality among stroke patients at North West Ethiopia. Risk Management and Healthcare Policy. 2021 Jul 14:2983-94.

2. Donkor ES. Stroke in the 21st century: a snapshot of the burden, epidemiology, and quality of life. Stroke research and treatment. 2018;2018(1):3238165.

3. Fricker M, Tolkovsky AM, Borutaite V, Coleman M, Brown GC. Neuronal cell death. Physiological reviews. 2018 Apr 1;98(2):813-80.

4. Haacke C, Althaus A, Spottke A, Siebert U, Back T, Dodel R. Long-term outcome after stroke: evaluating health-related quality of life using utility measurements. Stroke. 2006 Jan 1;37(1):193-8.

5. Jafari, M. and A. Dalvandi, Quality of life of stroke survivors and its related factors. Iran Journal of Nursing, 2014. 27(87): 14-22.

6. Gokkaya NK, Aras MD, Cakci A. Health-related quality of life of Turkish stroke survivors. International Journal of Rehabilitation Research. 2005 Sep 1;28(3):229-35.

7. Daniel K, Wolfe CD, Busch MA, McKevitt C. What are the social consequences of stroke for working-aged adults? A systematic review. Stroke. 2009 Jun 1;40(6):e431-40.

8. Pan JH, Song XY, Lee SY, Kwok T. Longitudinal analysis of quality of life for stroke survivors using latent curve models. Stroke. 2008 Oct 1;39(10):2795-802.

9. Carod-Artal FJ, Egido JA. Quality of life after stroke: the importance of a good recovery. Cerebrovascular diseases. 2009 Apr 1;27(Suppl. 1):204-14.

10. Lapchak, P.A. and J.H. Zhang, Neuroprotective therapy for stroke and ischemic disease. 2017: Springer.

11. Katoozian L, Tahan N, Mohseni Bandpei MA. Post stroke spasticity and related factors: a systematic review and meta-analysis. Journal of Mazandaran University of Medical Sciences. 2015 Apr 10;25(123):230-45.

12. Lapchak PA. Stroke Therapy Development Successes: Research Guidelines and Embolic Stroke Models for Monotherapy and Adjuvant Therapy Development. Translational Research in Stroke. 2017:3-27.

13. Zhao XJ, Li QX, Chang LS, Zhang J, Wang DL, Fan HY, Zheng FX, Wang XJ. Evaluation of the application of APACHE II combined with NIHSS score in the short-term prognosis of acute cerebral hemorrhage patient. Frontiers in neurology. 2019 Jun 21;10:475.

14. Sungono V, Hariyanto H, Soesilo TE, Adisasmita AC, Syarif S, Lukito AA, Widysanto A, Puspitasari V, Tampubolon OE, Sutrisna B, Sudaryo MK. Cohort study of the APACHE II score and mortality for different types of intensive care unit patients. Postgraduate medical journal. 2022 Dec;98(1166):914-8.

15. Tian Y, Yao Y, Zhou J, Diao X, Chen H, Cai K, Ma X, Wang S. Dynamic APACHE II score to predict the outcome of intensive care unit patients. Frontiers in Medicine. 2022 Jan 26;8:744907.

16. Hosseini M, Ramazani J. Evaluation of Acute Physiology and Chronic Health Evaluation II and sequential organ failure assessment scoring systems for prognostication of outcomes among Intensive Care Unit's patients. Saudi journal of anaesthesia. 2016 Apr 1;10(2):168-73.

17. Norouzi K, Mashmool Z, Dalvandi A, Soleimani M. Comparison of two tools APACHE IV and SAPS II in predicting mortality rate in patients hospitalized in intensive care unit. Koomesh. 2015 Jan 1;16(3):347-55.

18. Bahrami N, Soleimani MA, Shraifnia SH, Shaigan H, Masood R, Ranjbar H. Predicted duration of hospital stay and percentage of mortality in patients intensive care unit with apache IV. Studies in Medical Sciences. 2012 Oct 10;23(4):375-80.

19. Mahshidfar, B., et al., The relationship between APACHE-II scoring system and mortality of patients admitted to the emergency intensive care unit (EICU) and comparing it to those of the patients admitted to the medical and surgical intensive care units (MICU and SICU). Razi Journal of Medical Sciences, 2016. 23(142):26-33

20. Bahtouee M, Eghbali SS, Maleki N, Rastgou V, Motamed N. Acute Physiology and Chronic Health Evaluation II score for the assessment of mortality prediction in the intensive care unit: a single-centre study from Iran. Nursing in critical care. 2019 Nov;24(6):375-80.

21. Kim JY, Lim SY, Jeon K, Koh Y, Lim CM, Koh SO, Na S, Lee KM, Lee BH, Kwon JY, Lee KH. External validation of the Acute Physiology and Chronic Health Evaluation II in Korean intensive care units. Yonsei Medical Journal. 2013 Jan 22;54(2):425.