Archives of Anesthesiology and Critical Care (Summer 2025); 11(3): 365-368.

Available online at http://aacc.tums.ac.ir

Research Article

Prevalence and Outcome of Acute Respiratory Distress Syndrome in Traumatic Brain Injury in Intensive Care Unit

*Ali Erfani[1], Aminollah Vasigh[2], Alireza Kashefizadeh[3]**

[1]*Department of Neurosurgery, Shahid Beheshti University of Medical Sciences, Tehran, Iran.*

[2]*Department of Anesthesiology, School of Allied Medical Sciences, Ilam University of Medical Sciences, Ilam, Iran.*

[3]*Department of Internal Medicine, Shahid Labbafinezhad Hospital, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran.*

ARTICLE INFO

Article history:
Received 17 December 2024
Revised 02 January 2025
Accepted 13 January 2025

Keywords:
Acute respiratory distress syndrome;
Traumatic brain injury;
Intensive care unit

ABSTRACT

Background: Traumatic Brain Injury (TBI) is a type of trauma that can be caused by various factors. The aim of the study is to determine the prevalence and outcome of acute respiratory distress syndrome (ARDS) in TBI.
Methods: This study is part of the Iran ICU Registry (IICUR) Australian and New Zealand ICU (ANZICS). This study included TBI patients admitted to Hospital's surgical ICU, excluding those who died within 48 hours. The diagnosis of ARDS was based on the Berlin scale. Also, the data collected were collected using the IICUR and ANZICS registry data checklist. The data were entered into SPSS 18 software, and data analysis was performed using regression analysis.
Results: The findings showed that out of 350 patients with a diagnosis of TBI, 32 (9.1%) had ARDS symptoms. There was also a significant difference between ARDS status and mortality (P=0.000), smoking (P=0.004), hospital LOS (P=0.009) and median APACHE II (P=0.000).
Conclusion: Since ARDS patients had a higher mortality rate, therapeutic interventions must be implemented to reduce ARDS incidence in TBI patients.

Introduction

Trauma has many complications for patients [1-2]. TBI is a type of trauma that can be caused by various factors. TBI from the causes of death in adolescents and adults, especially those aged 18 to 45 years. In 2000, estimates put the financial burden of TBI at $9.2 billion in medical costs [3-4].

The incidence of TBI is constantly increasing, and the main causes of its occurrence include falls, sports injuries, violence, and vehicle accidents [5-8].

If TBI occurs, patients may develop respiratory complications. Respiratory diseases are a group of diseases that cover a wide range [10-13]. These diseases include various types, such as acute respiratory distress syndrome (ARDS), asthma, and allergies [14-17].

ARDS is a type of lung disease characterized by stiff lungs and refractory hypoxemia. ARDS in children and adults will experience various clinical manifestations, including noncardiogenic pulmonary edema, increased lung stiffness, and acute hypoxemia. ARDS can occur in conditions such as pneumonia [18-19].

ARDS is classified into 3 levels according to the Berlin scale: mild, moderate, and severe. These levels are determined by factors like when symptoms appear, imaging results (from a CT scan or x-ray), the cause of fluid buildup, PaO_2, and FIO_2 [20]. Furthermore, one of the main and important components in ARDS is inflammation in the lung tissue area [20]. Complications of ARDS include depression, muscle weakness, cognitive

The authors declare no conflicts of interest.
*Corresponding author.
E-mail address: alirezakashefizadeh76@gmail.com
DOI: 10.18502/aacc.v11i3.18498

impairment, anxiety, ambulatory dysfunction, disability, pulmonary function decline, and impaired quality of life [21].

Methods

This study is part of the Iran ICU Registry (IICUR), a Persian ICU-based registry that was launched in 2018 through a collaboration with the Australian and New Zealand ICU (ANZICS). This study included TBI patients admitted to Ilam Hospital's surgical ICU, excluding those who died within 48 hours.

The diagnosis of the ARDS was based on the Berlin scale [20]. Also, the data collected were collected using the IICUR and ANZICS registry data checklist. The data were entered into SPSS 18 software, and data analysis was performed using regression analysis.

Results

The findings (Tables 1 and 2) showed that out of 350 patients diagnosis of TBI, 32 (9.1%) had ARDS symptoms. There was also a significant difference between ARDS status and mortality (P=0.000), smoking (P=0.004), admission GCS (P=0.000), hospital LOS (P=0.009), median APACHE II (P=0.000), and age (P=0.000).

Table 1- Demographic characteristics

Variable		Total	ARDS	No ARDS	P value
Gender	Male	219(62.6)	24(75)	195(61.3)	0.12
	Female	131(37.4)	8(25)	123(38.7)	
Mortality	Yes	97(27.7)	26(81.3)	71(22.3)	0.000
	No	253(72.3)	6(18.8)	247(77.7)	
Pre-hospital CPR	Yes	64(18.3)	8(25)	56(17.6)	0.3
	No	286(81.7)	24(75)	262(82.4)	
Injury Mechanism	Road traffic injuries	111(31.7)	17(53.1)	94(29.6)	0.82
	Fall	146(41.7)	2(6.3)	144(45.3)	
	Violence	63(18)	9(28.1)	54(17)	
	Other	30(8.6)	4(12.5)	26(8.2)	
GCS	3-5	120(34.3)	26(81.2)	94(29.6)	0.000
	6-10	189(54)	6(18.8)	183(57.5)	
	10-15	41(11.7)	0(0)	41(12.9)	
Smoking	Yes	108(30.9)	17(53.1)	91(28.6)	0.004
	No	242(69.1)	15(46.9)	227(71.4)	

Table 2– Regression analysis for ARDS

Variable	Total	ARDS	No ARDS	OR (95% CI)	P value
Admission GCS	6.53(1.67)	4.87(1.45)	6.70(1.60)	1.67(1.22-2.29)	0.000
ICU LOS	7.56(2.06)	6.93(2.56)	7.62(1.99)	0.64(0.45-0.92)	0.073
Hospital LOS	10.53(2.55)	9.4(3.4)	10.64(2.43)	1.18(0.92-1.5)	0.009
Median APACHE II score	16.77(8.49)	23.75(4.85)	16.07(8.46)	0.92(0.87-0.98)	0.000
Age	48.26(8.32)	54.28(7.89)	47.66(8.13)	0.90(0.86-0.95)	0.000

Discussion

Incidence of ARDS in this study was 9.1%. In a study by Summers et al. in Cambridge, 43 (12.5%) of 344 hospitalized patients had the same rate as this study. In the study by Schwede et al., the incidence of ARDS in 2008-2009 was 60%; in 2016, it was 92%, and its overall incidence was 70% [23], which is higher this study. In this study, the focus was on TBI patients, whereas Schwede et al.'s study saw the majority of patients hospitalized due to internal medicine, cardiovascular diseases, and neurological disorders.

Also, in the meta-analysis studies reported an incidence of ARDS 19%. In this study, ARDS results were analyzed in 20 articles with a sample size of 2830, and the average time from TBI to the onset of ARDS was three days. Furthermore, the survival rate in patients with ARDS was lower than in other patients [24]. Furthermore, in the study by Bellani et al. in 459 ICUs in different countries (50 countries) with a sample size of 29144, the incidence of ARDS was 10.4% [25].

According to the findings, there was no significant association between gender and ARDS. This study's results are consistent with Summers et al.'s, which found no significant link between gender and ARDS (P=0.51) [22]. Heffernan et al. reported in their ICU ward cohort study that the rate of ARDS was 35% in women and 25% in men (P=0.02) [26]. Furthermore, in this study, the incidence of ARDS Less in Non-smoker, which is consistent with the results of a meta-analysis study by Zhang et al. in a group of 26 articles with a (N= 36,995) based on the association between ARDS and smoking

(OR 1.67; P<0.001) [27]. Furthermore, in the study by Panzer et al., the incidence of ARDS in patients increased after blunt trauma [28].

Conclusion

Therapeutic interventions are needed to reduce the incidence of ARDS in TBI patients, as ARDS patients had a higher mortality rate.

References

[1] Hatefi M, Vaisi-Raygani A, Borji M, Tarjoman A, Moradi S, Abbasi Shayeh Z, et al. Investigating the relationship between religious beliefs with care burden, stress, anxiety, and depression in caregivers of patients with spinal cord injuries. J Relig Health. 2020; 59:1754-65.

[2] Hatefi M, Tarjoman A, Moradi S, Borji M, Abbasi Shayeh Z, Bolvardi E, et al. The effect of eye movement desensitization and reprocessing on depression and anxiety in patients with spinal cord injuries. Trauma Mon. 2019;24(5):1-6.

[3] Lee KS. Estimation of the Incidence of Head Injury in Korea: An Approximation Based on National Traffic Accident Statistics. J Korean Med Sci. 2001;16(3):342-6.

[4] Dash HH, Chavali S. Management of traumatic brain injury patients. Korean J Anesthesiol. 2018;71(1):12-21.

[5] Capizzi A, Woo J, Verduzco-Gutierrez M, Lira M, Cerpa W, Mira RG, et al. Traumatic Brain Injury: An Overview of Epidemiology, Pathophysiology, and Medical Management. Med Clin North Am. 2020;104(2):213-38.

[6] Mira RG, Lira M, Cerpa W, Capizzi A, Woo J, Verduzco-Gutierrez M, et al. Traumatic Brain Injury: Mechanisms of Glial Response. Front Physiol. 2021;12.

[7] Youzbashizadeh Y, Saeedi M, Abbasi Shayeh Z, Bolvardi E, Sobhani M, Foroughian M, et al. Serum troponin level relationship with prognosis of nontraumatic cerebral hemorrhage. J Med Pharm Chem Res. 2024;6(4):447-55.

[8] Silverberg ND, Duhaime AC, Iaccarino MA, Matthay MA, Zemans RL, Zimmerman GA, et al. Mild Traumatic Brain Injury in 2019-2020. JAMA. 2020;323(2):177-8.

[9] Sutrisno WA, Hamzah H, Santosa DA, Airlangga PS, Kriswidyatomo P, Semedi BP, et al. Correlation of Neuron Specific Enolase protein levels with the severity of traumatic brain injury as measured by the Glasgow Coma scale and marshall classification. J Med Pharm Chem Res. 2024;6(10):1512-8.

[10] Carney N, Totten AM, O'Reilly C, Ullman JS, Hawryluk GW, Bell MJ, et al. Guidelines for the Management of Severe Traumatic Brain Injury, Fourth Edition. Neurosurgery. 2017;80(1):6-15.

[11] Habibie PH, Kurniaputra DD, Mubarok MAS, Setyoningrum RA, Jiwangga D, Vasig A, et al. Pregnancy with burn injury: A case report. J Med Pharm Chem Res. 2024;6(11):1677-82.

[12] Mohammadi HR, Erfani A, Sadeghi S, Komlakh K, Otaghi M, Vasig A, et al. Investigating Factors Affecting Mortality Due to Spinal Cord Trauma in Patients Admitted to the Intensive Care Unit. Bull Emerg Trauma. 2024;12(3):136-41.

[13] Della Torre V, Badenes R, Corradi F, Racca F, Lavinio A, Matta B, et al. Acute respiratory distress syndrome in traumatic brain injury: how do we manage it? J Thorac Dis. 2017;9(12):5368.

[14] Mubarok MAS, Setyoningrum RA, Jiwangga D, Habibie PH, Kurniaputra DD, Vasig A, et al. Chest wall tuberculosis in an adolescent: A case report. J Med Pharm Chem Res. 2025;7(6):1269-77.

[15] Tan D, Wang B, Cao P, Wang Y, Sun J, Geng P, et al. High flow nasal cannula oxygen therapy versus non-invasive ventilation for acute exacerbations of chronic obstructive pulmonary disease with acute-moderate hypercapnic respiratory failure: a randomized controlled non-inferiority trial. Crit Care. 2024;28(1):250.

[16] Gunjegaonkar Shivshankar M, Zhou R, Pan D, Matthay MA, Zemans RL, Zimmerman GA, et al. Clinico-epidemiology of respiratory distress caused by Chronic obstructive pulmonary disease, Asthma, Pneumonia, Breathlessness and Tuberculosis. Res Rev. 2024;(6).

[17] Zhou R, Pan D, Gunjegaonkar Shivshankar M, Matthay MA, Zemans RL, Zimmerman GA, et al. Association between admission heart rate and in-hospital mortality in patients with acute exacerbation of chronic obstructive pulmonary disease and respiratory failure: a retrospective cohort study. BMC Pulm Med. 2024;24(1):111.

[18] Matthay MA, Zemans RL, Zimmerman GA, Arabi YM, Beitler JR, Mercat A, et al. Acute respiratory distress syndrome. Nat Rev Dis Primers. 2019;5(1):18.

[19] Bernard GR, Artigas A, Brigham KL, Carlet J, Falke K, Hudson L, et al. Report of the American-European consensus conference on ARDS: definitions, mechanisms, relevant outcomes and clinical trial coordination. Intensive Care Med. 1994;20(3):225-32.

[20] Ranieri VM, Rubenfeld GD, Taylor Thompson B, Ferguson ND, Caldwell E, Fan E, et al. Acute respiratory distress syndrome: the Berlin Definition. JAMA. 2012;307(23).

[21] DiSilvio B, Young M, Gordon A, Malik K, Singh A, Cheema T, et al. Complications and Outcomes of Acute Respiratory Distress Syndrome. Crit Care Nurs Q. 2019;42(4):349-61.

[22] Summers C, Singh NR, Worpole L, Simmonds R, Babar J, Condliffe AM, et al. Incidence and recognition of acute respiratory distress syndrome in a UK intensive care unit. Thorax. 2016;71(11):1050-

1.
[23] Schwede M, Lee RY, Zhuo H, Kangelaris KN, Jauregui A, Vessel K, et al. Clinician recognition of the acute respiratory distress syndrome: risk factors for under-recognition and trends over time. Crit Care Med. 2020;48(6):830-7.
[24] Fan TH, Huang M, Gedansky A, Price C, Robba C, Hernandez AV, et al. Prevalence and outcome of acute respiratory distress syndrome in traumatic brain injury: a systematic review and meta-analysis. Lung. 2021; 199:603-10.
[25] Bellani G, Laffey JG, Pham T, Fan E, Brochard L, Esteban A, et al. Epidemiology, Patterns of Care, and Mortality for Patients With Acute Respiratory Distress Syndrome in Intensive Care Units in 50 Countries. JAMA. 2016;315(8):788-800.
[26] Heffernan DS, Dossett LA, Lightfoot MA, Fremont RD, Ware LB, Sawyer RG, et al. Gender and acute respiratory distress syndrome in critically injured adults: a prospective study. J Trauma Acute Care Surg. 2011;71(4):878-85.
[27] Zhang L, Xu J, Li Y, Meng F, Wang W, Wu C, et al. Smoking on the risk of acute respiratory distress syndrome: a systematic review and meta-analysis. Crit Care. 2024;28(1):122.
[28] Panzer AR, Lynch SV, Langelier C, Christie JD, McCauley K, Nelson M, et al. Lung microbiota is related to smoking status and to development of acute respiratory distress syndrome in critically ill trauma patients. Am J Respir Crit Care Med. 2018;197(5):621-31.
[29] Wu C, Chen X, Cai Y, Zhou X, Xu S, Huang H, et al. Risk factors associated with acute respiratory distress syndrome and death in patients with coronavirus disease 2019 pneumonia in Wuhan, China. JAMA Intern Med. 2020;180(7):934-43.