International Journal of Medicine

journal homepage: www.ijmjournal.org

Original Research Article

Special Issue: Pulmonary Medicine

An Observational Study on the Role of DECAF and HACOR Score in Predicting the Outcome of NIV and Mortality in Patients with Chronic Obstructive Pulmonary Disease

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HIGHLIGHTS

1. DECAF and HACOR score spredict outcomes.
2. NIV success linked to COPD severity.
3. Mortality risk assessed through scores.
4. Study focuses on COPD patient management.
5 Early intervention improves survival chances.

ARTICLE INFO

Handling Editor: Dr. Oliver Hastings

Key words:
Chronic obstructive pulmonary disease
HACOR
DECAF score
NIV failure.

ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD) is now one of the top three causes of death world wide and 90 % of death is in low income countries. Globally, the COPD burden is projected to increase in coming decades because of continued exposure to COPD risk factors and ageing of population. This study aims at using DECAF and HACOR scores in predicting NIV and mortality outcome in patients with chronic obstructive pulmonary disease as these scoring systems are simple and effective to improve their clinical outcome **Aim of The Study:** To evaluate the outcome of NIV and mortality in patients with chronic obstructive pulmonary disease using DECAF and HACOR score. To assess the severity of chronic obstructive pulmonary disease patients using DECAF and HACOR score. **Results:** HACOR exhibits excellent predictive power for anticipating NIV failure in COPD patients. Our study revealed a low NIV failure rate of only 16.6%, suggesting that NIV can be effectively utilized in the majority of COPD patients experiencing acute-on-chronic respiratory failure with respiratory acidosis. NIV failure is better predicted with HACOR score than DECAF score, HACOR score appears to have a higher discriminative ability, especially at the 24-hour mark, compared to the DECAF score. Sensitivity and specificity of HACOR is 77.8% and 79% at one hour. At 24hr sensitivity is 88.9% and specificity is 87.7%. In our study DECAF score predicted length of hospital stay better than HACOR score with p value of 0.003. Thus combining both scores in assessing NIV failure, length of hospital stay and mortality would be better. **Conclusion:** Combined HACOR and DECAF score have high sensitivity and specificity for predicting NIV failure, hospital mortality and length of hospital stay in a patients with acute exacerbation of COPD. DECAF and HACOR scoring system are simple tool which helps to detect patient with high risk for NIV failure thus better care can be given and helps to improve their clinical outcome.

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Received 08 September 2024; Received in revised form 29 September 2024; Accepted 06 October 2024

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a heterogeneous lung condition characterized by chronic respiratory symptoms (dyspnoea, cough, sputum production) due to abnormalities of the airways (bronchitis, bronchiolitis) and/or alveoli (emphysema) that cause persistent, often progressive, airflow obstruction[1]. Chronic Obstructive Pulmonary Disease (COPD)is now one of the top three causes of death world wide and 90 % of death is in low income countries. COPD represents an important public health challenge that is both preventable and treatable. COPD is a major cause of mortality and chronic morbidity throughout the world, many people suffer from this disease for years and die prematurely from it or its complications. Globally, the COPD burden is projected to increase in coming decades because of continued exposure to COPD risk factors and ageing of population[1].

Non-invasive ventilation (NIV), refers to a mode of respiratory support without direct tracheal intubation. Over the previous decades, the use of NIV has increased[2] . especially in a patients with COPD. By using NIV, medical professionals aim to reduce the incidence of intubation related complications such as cardiovascular instability (42.6%), severe hypoxia (9.3%) and cardiac arrest (3.1%)[3]. Hence, for patients with respiratory failure, noninvasive mask ventilation has proved to be an effective strategy to avoid endotracheal intubation, shorten duration of illness, and improve outcomes[4]. Guidelines strongly advise administering non-invasive ventilation (NIV) to patients with COPD[5,6].

While non-invasive ventilation (NIV) reduces the need for intubation in COPD patients, mortality rates significantly rise in cases of NIV failure[7,8]. Furthermore, delayed intubation among patients who experience NIV failure further exacerbates mortality[9]. Hence, timely identification of patients at risk of NIV failure and prompt intubation could potentially lower mortality rates.

Various scoring systems have been proposed to detect the early failure of the NIV, mortality, length of the hospital stay in patients with AECOPD.DECAF and HACOR scoring system are simple tool which helps to detect patient with high risk ,to detect the early NIV failure ,thus better care can be given and helps to improve their clinical outcome. Thus, this study intends to predict the NIV and mortality outcome using DECAF and HACOR score in COPD patients.This study aims to evaluate the outcomes of non-invasive ventilation (NIV) and mortality in chronic obstructive pulmonary disease (COPD) patients by utilizing the DECAF and HACOR scores, as well as to assess the severity of COPD in these patients using the same scoring systems.

METHODOLOGY

A Prospective observational study was conducted at Victoria hospital, Bangalore Medical college and Research Institute, Bangalore, a tertiary care hospital for a period of 2 months from May 2024 to June 2024.This study was cleared from Institutional ethical Committee, BMCRI to which the hospital is attached. Ninety patients were included in the study after getting informed written consent.

The study includes 90 samples COPD patients, diagnosed per GOLD guidelines, who require NIV and provide informed consent, excluding those needing emergency intubation, with recent trauma/surgery, high aspiration risk, or active GI bleeding. Admitted patients undergo history, clinical examination, chest X-ray, ABG, and DECAF/HACOR score assessments. NIV is initiated when pH ≤7.35, PaCO2 >45 mmHg, and respiratory rate >24 breaths/min, with DECAF and HACOR scores tracked to monitor NIV failure, mortality, and hospital stay duration.

STATISTICAL ANALYSIS

Data will be entered in Microsoft Excel and analyzed using SPSS version 27.0, with results presented through descriptive statistics such as mean, standard deviation, and percentages. Appropriate statistical tests, including Independent T-test/Mann-Whitney U, ANOVA/Kruskal-Wallis, and Chi-square, will be used to determine significant differences and associations, with $P < 0.05$ considered statistically significant. Results will be displayed in tables, figures, and graphs as needed.

RESULTS

Among 90 patients the age ranged from 35 to 95 years, with a mean age of 61 years, and the study population have 54 male (60%) 36 Female (40%

Table 1: ABG at the Time of Admission

ABG (At the Time of Admission)					
		Minimum	**Maximum**	**Mean**	**Std Deviation**
PH	90	7.080	7.50	7.296	0.0950
PCO_2	89	37	115	69.18	16.211
pO_2	90	25	230	68.58	42.277
HCO_3	88	19.9	78.0	32.363	7.3819

ABG of the patient before initiation of NIV at the time of admission with minimum PH of 7.08,maximum PH of 7.5, mean PH of 7.26 with standard deviation of 0.0950.

Table 2: ABG After One Hour of NIV

ABG (At One hr of NIV)					
		Minimum	**Maximum**	**Mean**	**Std Deviation**
PH	90	7.09	7.47	7.314	0.080
PCO_2	90	38	112	67.84	15.146
pO_2	90	25	186	67.42	18.763
HCO_3	89	19	56	32.28	6.563

ABG of the patient after one hour of NIV usage with Minimum PH of 7.09, maximum PH -7.47, mean PH-7.31, standard deviation-0.08. After the NIV usage ABG showed improvement.

Table 3: ABG After 24 Hour of NIV Usage

ABG After 24 hr of NIV					
		Minimum	**Maximum**	**Mean**	**Std deviation**
PH	90	7.14	7.52.00	7.8523	4.70657
PCO_2	90	29	106	63.00	16.750
pO_2	90	17	157	63.40	23.847
HCO_3	89	17.0	58.0	34.052	7.6340

ABG of the patient after one hour of NIV usage with Minimum PH of 7.14, maximum PH -7.52, mean PH-7.8, standard deviation-4.7

Table 4: DECAF Score at Admission, After One Hour and 24 Hour of NIV Usage

DECAF Score							
	N	**Min**	**Max**	**Mean**	**SD**	**Median**	**IQR**
DECAF At Admission	90	0	4	2.56	0.795	3	2-3
DECAF After 1 hr	90	0	4	2.41	0.873	2	2-3
DECAF After 24h	90	0	4	2.16	0.847	2	2-3

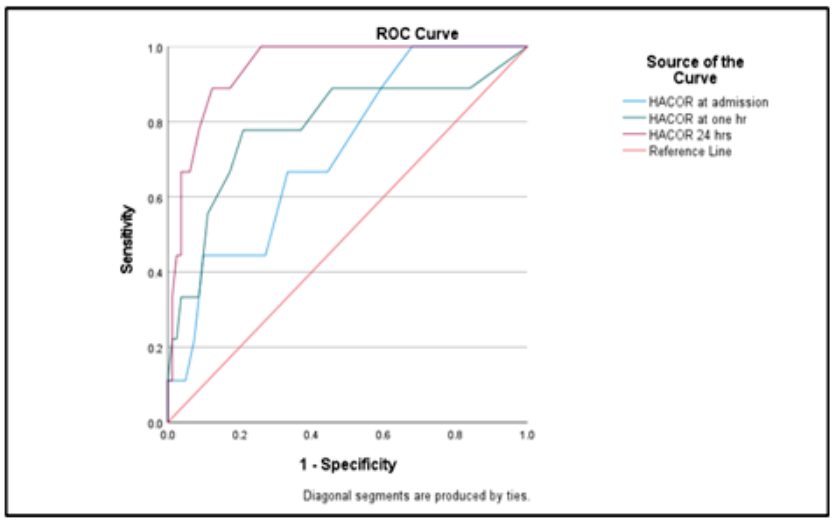
In our study Minimum DECAF score is o and Maximum DECAF score is 4 with interquartile range between 2-3.

Table 5: ROC Analysis of HACOR Score

Area Under the Curve					
Test Result Variable(s)	**Area**	**Std. Error[a]**	**P-value**	**Asymptotic 95% Confidence Interval**	
				Lower Bound	**Upper Bound**
HACOR At Admission	0.721	0.081	0.030	0.562	0.880
HACOR At 1hr	0.789	0.095	0.005	0.602	0.976
HACOR 24 hrs	0.943	0.028	0.000	0.888	0.998

The HACOR score at admission, with a threshold of 9.5, demonstrates a sensitivity of 44.4% and a specificity of 90.1%. After 1 hour, at a score of 6.5, the sensitivity increases to 77.8% and specificity to 79%. After 24 hours, with a score of 5.5, the HACOR score shows a further improved sensitivity of 88.9% and specificity of 87.7%.

Figure 1: ROC Curve Interpretation for HACOR Score



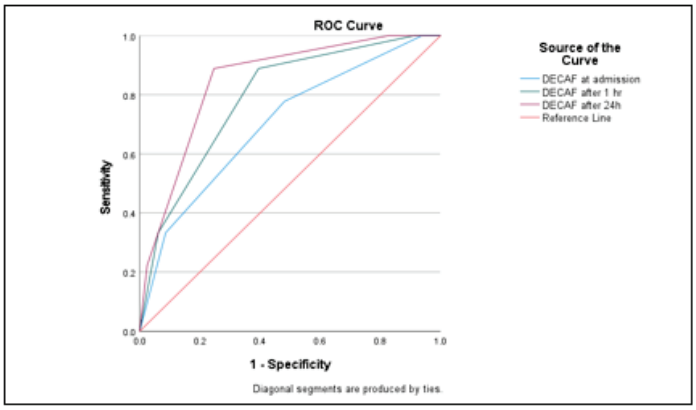
The predictive accuracy of the HACOR score increases progressively over time, reaching its highest performance 24 hours after NIV initiation, with an AUC of 0.943. Across all time intervals, the model consistently shows statistically . significant results, with the strongest performance at the 24-hour mark. At this point, the HACOR score demonstrates excellent sensitivity (88.9%) and specificity (87.7%), highlighting its reliability as a predictive tool for identifying NIV failure

Table 6: ROC Analysis of DECAF Score

Area Under the Curve					
Test Result Variable(s)	Area	Std. Error[a]	P-value	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
DECAF At Admission	0.702	0.093	0.048	0.520	0.883
DECAF After 1 hr	0.790	0.073	0.004	0.647	0.933
DECAF After 24h	0.847	0.061	0.001	0.728	0.966

P value is less than 0.05, means there is significant difference between the DECAF taken at different times. The area under curve is more for DECAF at 24 hours means that has more sen-sitivity and specificity than DECAF at admission and 1hour.i,e with usage of NIV DECAF score improved over 24 hours thus it helps to detect the NIV failure.

Figure 2: **ROC Curve Interpretation for DECAF Score**



The predictive capability of the DECAF score for detecting NIV failure strengthens over time, reaching its peak performance after 24 hours with an AUC of 0.847. The model consistently shows statistically significant results across all time points, with greater significance and improved performance observed in the later intervals.

Table 7: Comparison of NIV failure Vs NIV Success Against Survival and Death

	Number	Survival	Died
NIV failure (Intubated)	15(16.6%)	6(40%)	9(60%)
NIV success	75(83.3%)	75(100%)	0(0%)
Total	90	81	9

In our study among 90 patients 15 patients got intubated-Indic--ated NIV failure among them 6 (40%)survived and 9(60%) Died.

Table 8: Mortality Among Study Population

Mortality			
		Frequency	**Percent**
Valid	**NIL**	81	90.0
	DIED	9	10.0
	Total	90	100.0

In our study among 90 patients 81(90%) patients survived 9(10%) patients died

Table 9: Hospital Stay Among Study Population

Comparison of hospital stay						
Mortality		**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**	**p-value**
	NIL	81	7.72	3.210	0.357	0.404
	DIED	9	6.67	6.042	2.014	

In our study mean duration of hospital stay among survival patients is 7 days and among non survival patients is 6 days.

Table 10: Correlation Between DECAF, HACOR Scores and Morality, Hospital Stay

Pearson Correlation Test - Correlation Between DECAF, HACOR Scores and Mortality, Hospital Stay (N=90)		
Variables	**R**	**P-Value**
DECAF & Mortality	0.378	<0.0001*
DECAF & Hospital stay	0.226	0.003*
HACOR & Mortality	0.609	<0.0001*
HACOR & Hospital stay	0.209	0.048*

***There is Significant Correlation Between Above Mentioned Variables**

DECAF score has better correlation in terms of Hospital staythan HACOR score with p value of 0.003.

DISCUSSION

In this study, we focused on patients with chronic obstructive pulmonary disease (COPD) who were experiencing acute-on-

chronic respiratory failure, a critical condition that requires immediate and effective intervention. Non-invasive ventilation (NIV) has emerged as a pivotal treatment option for such patients, offering a less invasive alternative to intubation and mechanical ventilation. The study aimed to assess the predictive power of the HACOR and DECAF scores in determining the likelihood of NIV failure, hospital mortality, and length of hospital stay in these patients.

The study included a cohort of COPD patients who were admitted with acute exacerbations complicated by respiratory acidosis, necessitating the use of NIV. Acute exacerbations of COPD (AECOPD) often result in respiratory failure, which is a leading cause of morbidity and mortality in these patients. The use of NIV in this context is well-established, as it can reduce the need for intubation, lower the risk of hospital-acquired infections, and improve patient outcomes. However, the success of NIV is not guaranteed, and identifying patients at risk of NIV failure is crucial for timely intervention and improving prognosis.

One of the significant findings of our study was the low incidence of NIV failure, observed in only 16.6% of the patients. This low failure rate suggests that NIV is an effective treatment modality for the majority of COPD patients experiencing acute-on-chronic respiratory failure with respiratory acidosis. The success of NIV in this study population can be attributed to the early initiation of treatment, careful patient selection, and continuous monitoring of clinical parameters. These factors likely contributed to the high success rate and low incidence of complications associated with NIV use in this setting.

The HACOR score, which evaluates five critical parameters-heart rate, acidosis, consciousness, oxygenation, and respirator y rate-demonstrated excellent sensitivity and specificity in predicting NIV failure. When assessed within 24 hours of initiating NIV, the HACOR score exhibited a sensitivity of 88.9% and a specificity of 87.7%, indicating its robustness as a predictive tool. These findings underscore the HACOR score's ability to identify patients at high risk of NIV failure early in the treatment process, allowing for timely adjustments in the clinical management plan.

The HACOR score's predictive power is particularly noteworthy when compared to the DECAF score, which also evaluates COPD severity but through different parameters such as dyspnea, eosinopenia, consolidation, acidemia, and atrial fibrillation. While both scores are valuable, our study found that the HACOR score had a higher discriminative ability, especially at the 24-hour mark. This suggests that the HACOR score may be more sensitive to the acute physiological changes associated with NIV failure, making it a more reliable tool in this specific clinical scenario.

While the HACOR score was superior in predicting NIV failure, the DECAF score also played a crucial role in the overall assessment of the patients. Notably, the DECAF score was found to be more effective in predicting the length of hospital stay. Our statistical analysis revealed that the DECAF score was significantly associated with prolonged hospital stays, with a p-value of 0.003. This finding highlights the importance of the DECAF score in the comprehensive management of COPD patients, particularly in planning post-acute care and resource allocation.

Moreover, the DECAF score also demonstrated its utility in predicting mortality. Our study showed that the highest mortality was observed in patients with DECAF scores between three and four. This aligns with findings from other studies, such as the research conducted by Memon et al., which reported a 92% mortality rate in patients with DECAF scores between three and five. These findings emphasize the DECAF score's role as a prognostic tool, particularly in identifying patients at the highest risk of adverse outcomes.

Given the strengths of both the HACOR and DECAF scores in different aspects of patient assessment, our study suggests that combining these scores could provide a more comprehensive evaluation of patients with AECOPD. The HACOR score's superior ability to predict NIV failure, coupled with the DECAF score's effectiveness in forecasting hospital stay duration and mortality, offers a more holistic approach to patient management.

By integrating both scores into clinical practice, healthcare providers can better stratify patients into risk categories, predict outcomes more accurately, and make informed decisions regarding the level of care and appropriate interventions. This combined approach could potentially lead to improved patient outcomes, reduced hospital stays, and more efficient use of healthcare resources.

Our study highlights the critical role of predictive scoring systems in the management of COPD patients undergoing NIV. The HACOR score, with its high sensitivity and specificity, is an excellent tool for anticipating NIV failure, particularly within the first 24 hours of treatment. On the other hand, the DECAF score provides valuable insights into the likely duration of hospital stay and the risk of mortality. By combining these two scores, clinicians can enhance their ability to predict outcomes and tailor treatment plans to the needs of individual patients, ultimately improving the prognosis for those with acute-on-chronic respiratory failure.

CONCLUSION

The combined HACOR and DECAF scores demonstrate high sensitivity and specificity in predicting NIV failure, hospital mortality, and length of stay in patients with acute exacerbation of COPD. Statistical analysis shows that higher DECAF and HACOR scores correlate with increased mortality and the need for intubation (NIV failure). Our findings suggest that a simple clinical prediction tool using readily available indices can effectively stratify patients with acute COPD exacerbations into relevant risk categories and detect early NIV failure. This tool can enhance prognostic accuracy, guide care decisions, and improve patient outcomes.

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