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Comparative analysis of The BAP-65, DECAF & Modified DECAF Scores in Prognostication of Patients Hospitalized with Acute Exacerbation of Chronic Obstructive Pulmonary Disease

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Abstract

Background: Several multifactorial prognostic tools have been studied for patients with chronic stable COPD, but there are scarce data regarding prognosis after acute exacerbations and none of them is yet widely validated or recommended to be used in clinical practice.

Aim of The Study: Comparative analysis of the three recent different scores BAP-65, DECAF and Modified DECAF in prognostication of AECOPD patients for in-hospital mortality and need for mechanical ventilation.

Materials and Methods: 92 patients over a period of 1 year with primary diagnosis of AECOPD are enrolled after satisfying inclusion and exclusion criteria. All patients are scored according to BAP-65, DECAF and Modified DECAF scoring system. Need for mechanical ventilation and final in-hospital outcome which is categorized as (a) Improved, (b) Mortality and (c) Undefined, are recorded.

Results: Modified DECAF score has better prognostic sensitivity and specificity for predicting in-hospital mortality than both the DECAF and BAP-65 scores. ($AUROC_{DECAF}$ =0.836, vs $AUROC_{BAP-65}$=0.865 vs $AUROC_{Modified\ DECAF}$ =0.887, p- value 0.000). Accuracy for prediction of need for mechanical ventilation was more for modified DECAF score than the BAP-65 score and was least for the DECAF score.

Conclusions: The modified DECAF score is more sensitive and specific prognostic tool in terms of in-hospital mortality and need for mechanical ventilation than the other two scores.

Keywords: Acute exacerbations of COPD (AECOPD), DECAF , Modified DECAF , BAP-65.

Introduction

COPD is one of the leading cause of morbidity and mortality worldwide with substantial economic and social burden which is projected to increase in the coming decades because of continued exposure to COPD risk factors and aging of the population.[1]

COPD is defined independent of exacerbations, but acute exacerbations are important events in the management of COPD because they are an important cause of morbidity and mortality in COPD patients and also deeply influence the health-related quality of life. Between 1% and 2% of all emergency service visits and 10% of all hospital admissions are directly or indirectly attributable to acute exacerbations of COPD.[2]

The Global Initiative for Chronic Obstructive Lung Disease (GOLD) defines an acute exacerbation of COPD as "an acute worsening of respiratory symptoms that results in additional therapy." Most exacerbations in patients with COPD are relatively mild, requiring only outpatient care, but 3–16% of these require hospital admission, and some cases are severe enough to result in respiratory failure requiring ICU intervention.[3]

Several multifactorial prognostic scores have been meticulously studied for patients with chronic stable COPD but there are limited data regarding prognosis after acute exacerbations. Different authors in their different studies have proposed the number of prognostic scores with little variations in sensitivity and specificity but till now no score can be considered absolutely accurate.

Recently few clinical tools such as CURB-65, BAP-65, DECAF and Modified DECAF score have been tested to assess the prognosis of AECOPD to help clinicians in taking proper decisions regarding admission and level of adequate therapeutic care.

The use of CURB-65 score (W.S. Lim *et al*, 2002) for assessment and guidance of therapy in patients hospitalized with AECOPD complicated with consolidation has been shown to be suboptimal.[4]

A new model BAP-65 developed by Shorr *et al* (2011) showed the ability to predict mortality and need for MV during hospitalization of patients with AECOPD.[5]

DECAF score has been added very recently to the tools by Steer *et al*. (2012) who proposed it as a stronger prognostic score than CURB-65, APACHE, or COPD and Asthma Physiological Score (CAPS) predictive tools.[6]

Later Zidan *et al* (2014) found the Frequency of admissions to be the most linked factor to mortality in AECOPD, so devised the new Modified DECAF score by replacing the atrial fibrillation with frequency of admissions and found it to be more sensitive and more specific in predicting in-hospital mortality than the DECAF score.[7]

Hence the aim of this work was to compare the performance of the three different scores BAP-65, DECAF & Modified DECAF regarding their ability not only to predict in-hospital mortality but the need for mechanical ventilation as well.

Materials & Methods

The present prospective, observational study was carried out on 92 consecutive patients of COPD with acute exacerbation admitted in the emergency department of tertiary care center during the period of one year. Patients with primary diagnosis of acute exacerbation of pulmonary disease, age >40 years (to minimize potential patients with Asthma) irrespective of their smoking status were included in the study. Patients with previous inclusion in the study, on domiciliary ventilation, comorbidity expected to limit survival to <1 year (principally metastatic malignancy) and with the primary reason for admission other than AECOPD were excluded from the study. After the initial evaluation, comprising of clinical history, general physical & systemic examination, routine laboratory tests, 12-lead electrocardiography (ECG), chest X-ray, and arterial blood gas analysis (ABG), all patients underwent dyspnea scoring using the extended Medical Research Council Dyspnoea (eMRCD) score, DECAF score, modified DECAF score and BAP-65 score (Table 1).

The clinical outcome is categorized as:

A) Improved, B) Mortality, C) Undefined

"Improved" is clinically defined as the subjective and objective sense of improvement as noted by the patient and assessed by the clinician. "Undefined" refers to patients who remain unimproved and left against medical advice or absconded or requested premature discharge.

Statistical Analysis

The results were statistically analyzed using the IBM SPSS Statistics software package version 23.0

Significance of correlation between variables was assessed using *p*-value ($p<0.05$). The area under receiver operating characteristic curve was used to analyze and compare the diagnostic value of the scores.

Observations & Results

The age of 92 patients (Male=59 / Female=33) in the study ranged from 44 to 85 years with mean age of 67.435 years ± 9.9287. 81.5% of patients improved during their hospital stay and discharged, 14.1% of patients died in the hospital, and 4.3% of patients left the hospital against medical advice whose final outcome could not be defined.

TABLE 1: DECAF, MODIFIED DECAF & BAP-65 SCORE

variables	DECAF score	Modified DECAF score
Dyspnea limiting the patient to home (MRCD 5) and- - Independent in bathing and/or dressing (eMRCD 5a) -Requires assistance with bathing and dressing (eMRCD 5b)	 1 2	
Eosinopenia (<0.05 × 10^9/L)	1	
Consolidation	1	
Acidemia (pH< 7.30)	1	
Atrial **F**ibrillation	1	-
Frequency of admission (by AECOPD in last year ≥ 2)	-	1
Total score	6	6

BAP-65 score	0 point	1 point
BUN ≥25=Urea >53.5mg/dl	No	Yes
Altered mental status	No	Yes
Pulse ≥109/min	No	Yes

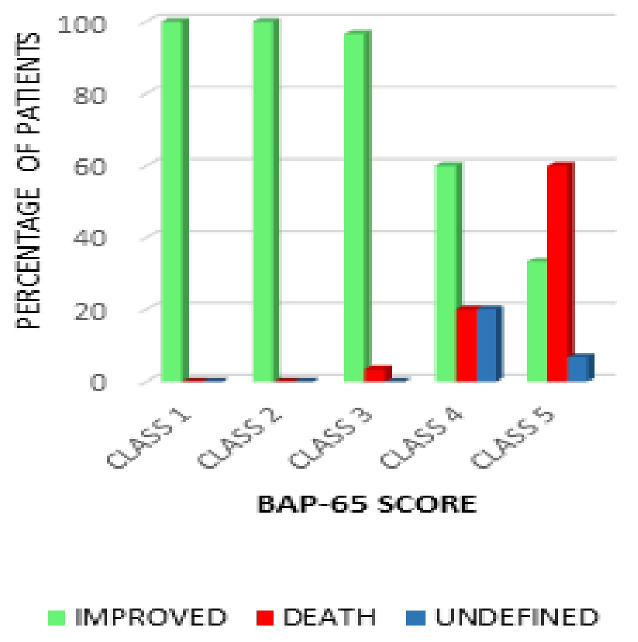
CLASS	**BAP**	**AGE**
I.	0	< 65 years
II.	0	≥65 years
III.	1	Any age
IV.	2	Any age
V.	3	Any age

BAP-65 score and outcomeThe mortality rate increased with increasing BAP-65 class, which has a statistically significantassociation (P-value=0.000) (Figure 1). In-hospital mortality is < 1% in patients with BAP-65 class of zero, while it jumps to > 50% in patients with BAP-65 class of 5 (Table 2).

TABLE 2: BAP-65 CLASS AND OUTCOME

BAP-65 Class		**Outcome**			**Total**
		Improved	Death	Undefined	
1	Count	16	0	0	16
	% within BAP65 CLASS	100.0%	0.0%	0.0%	100.0%
	% within OUTCOME	21.3%	0.0%	0.0%	17.4%
2	Count	17	0	0	17
	% within BAP65 CLASS	100.0%	0.0%	0.0%	100.0%
	% within OUTCOME	22.7%	0.0%	0.0%	18.5%
3	Count	28	1	0	29
	% within BAP65 CLASS	96.6%	3.4%	0.0%	100.0%
	% within OUTCOME	37.3%	7.7%	0.0%	31.5%
4	Count	9	3	3	15
	% within BAP65 CLASS	60.0%	20.0%	20.0%	100%
	% within OUTCOME	12.0%	23.1%	75.0%	16.3%
5	Count	5	9	1	15
	% within BAP65 CLASS	33.3%	60.0%	6.7%	100%
	% within OUTCOME	6.7%	69.2%	25.0%	16.3%
TOTAL	Count	75	13	4	92
	% within BAP65 CLASS	81.5%	14.1%	4.3%	100.0%
	% within OUTCOME	100.0%	100.0%	100.0%	100.0%

Figure 1: BAP-65 Class & Outcome



DECAF score and OutcomeHigher the DECAF score, the higher is the mortality. This relation is statistically significant at p=0.000 (Figure 2). There is no mortality in patients with DECAF scores between 0-1. The mortality rate is 8.7% for patients getting a score of 2 and 30.5% for score 3 and above (Table3).

Figure 2: DECAF Score & Outcome

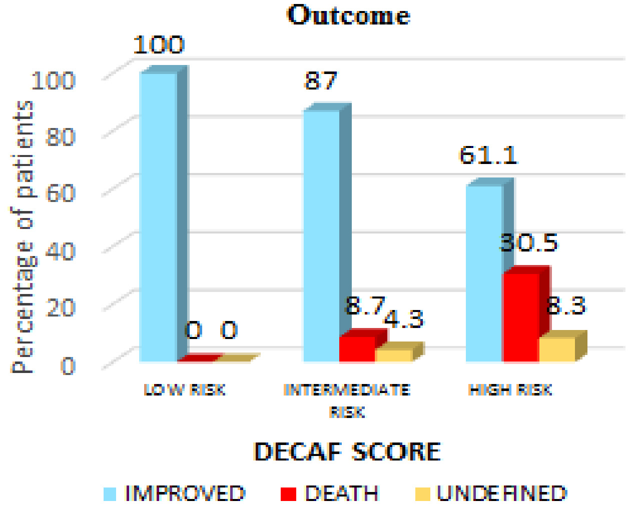
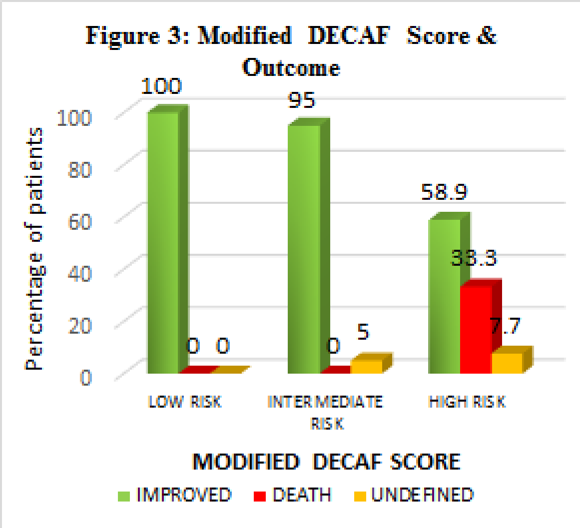


TABLE 3: DECAF SCORE AND OUTCOME				
DECAF SCORE	OUTCOME			TOTAL
	IMPROVED	DEATH	UNDEFINED	
0-1 (LOW RISK)	33 (100%)	0 (0.0%)	0 (0.0%)	33
2 (INTERMEDIATE RISK)	20 (87%)	2 (8.7%)	1 (4.3%)	23
3-6 (HIGH RISK)	22 (61.1%)	11 (30.5%)	3 (8.3%)	36
TOTAL	75	13	4	92

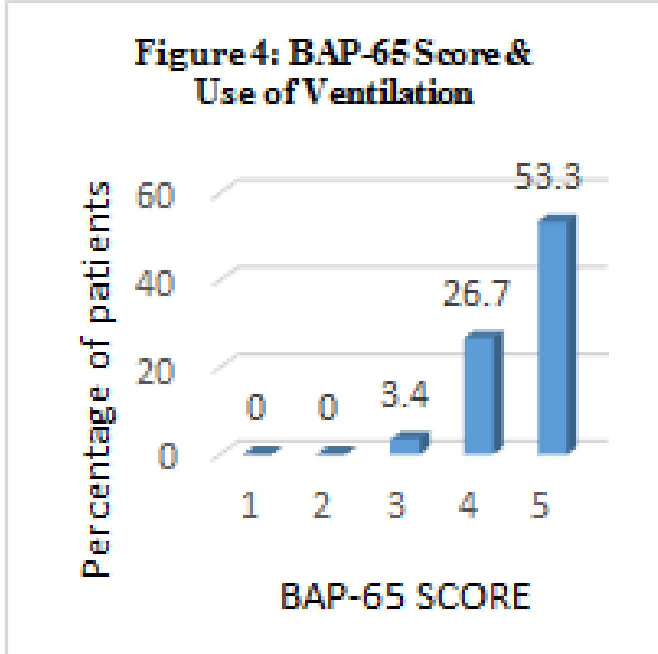
Modified DECAF Score and Outcome There is no mortality in patients with modified DECAF score between 0-2. The mortality rate for patients getting a score of 3 and above was 13 out of 39 (33.3%) (Table 4).Higher the score, the higher is the mortality. This relation is statistically significant at p=0.000.(Figure3).

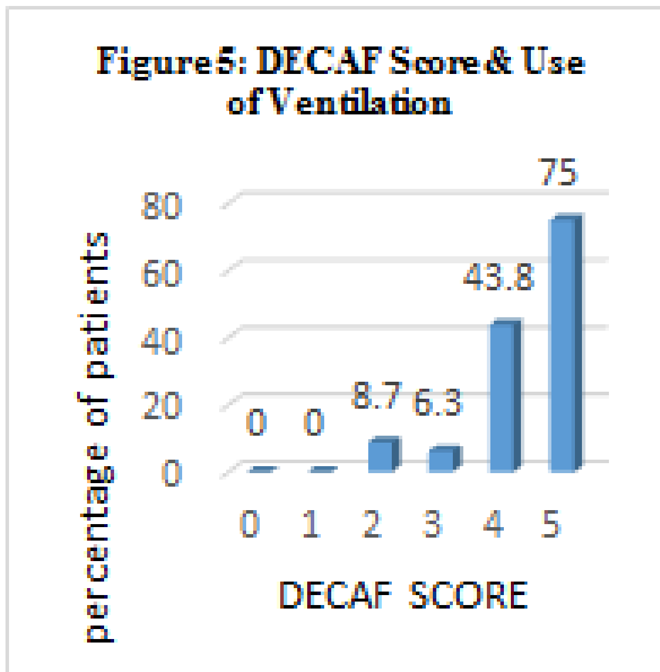
TABLE 4: MODIFIED DECAF SCORE AND OUTCOME				
MODIFIED DECAF SCORE	OUTCOME			TOTAL
	Improved	Death	Undefined	
0-1 (LOW RISK)	33 (100%)	0 (0.0%)	0 (0.0%)	33
2 (INTERMEDIATE RISK)	19 (95.0%)	0 (0.0%)	1 (5.0%)	20
3-6 (HIGH RISK)	23 (58.9%)	13 (33.3%)	3 (7.7%)	39
TOTAL	75	13	4	92



Use of Mechanical Ventilation

In this study total, 13 patients (14.1%) needed mechanical ventilation among which 1, 4, 8 patients belong to BAP-65 class 3, 4, 5 respectively i.e. use of mechanical ventilation is about 3.4% in class 3 and increased to >50% in class 5. This association is statistically significant at $\chi2$=29.100; p=0.000 (Figure 4).In the low-risk group of DECAF score, no patient was intubated. The use of mechanical ventilation was 8.7% in the intermediate-risk group while it was 30.6% in patients who were in the high-risk group. This has statistically significant association at $\chi2$= 30.592 with p=0.000 (Figure 5). According to modified DECAF score, there is an incremental increase in the number of patients requiring MV with the increasing score viz. 13.3%, 33.3%, 50% & 75 % with the score 3, 4, 5 and 6 respectively (figure 6) and this is statistically significant at $\chi2$=33.073, p=0.000.





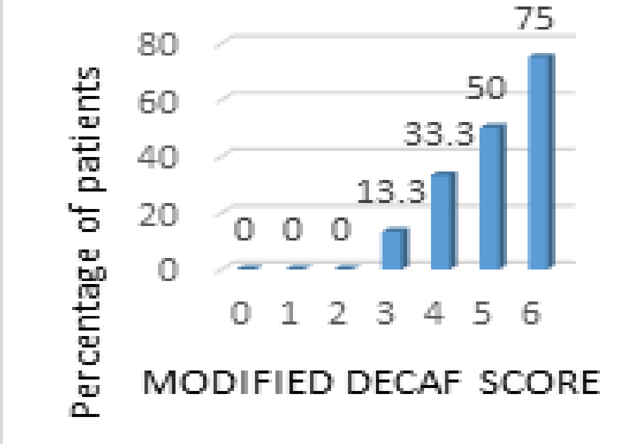
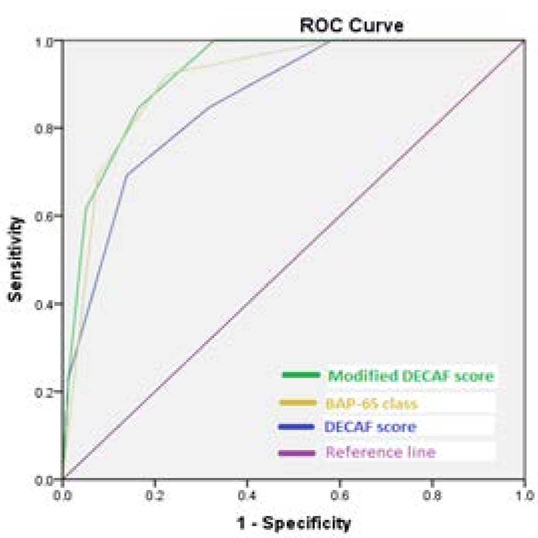


Figure 6: Modified DECAF Score & Use of Ventilation

Mortality & Prognostic Tools

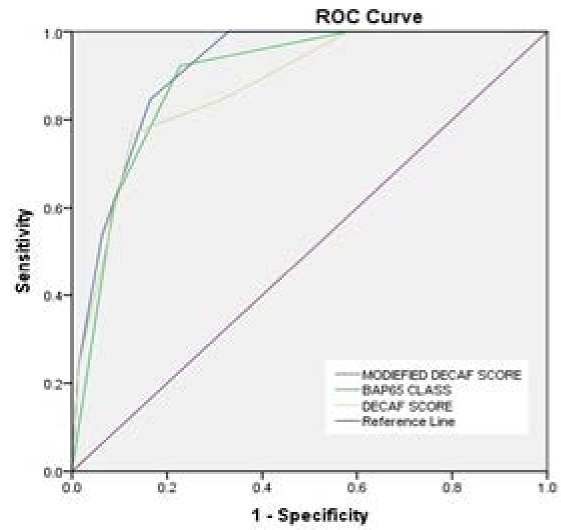
In comparison with the DECAF score in our study, BAP-65 score is found to be more sensitive and specific for prediction of in-hospital mortality but the modified DECAF score is found to have the highest accuracy among all the three scores in predicting in-hospital AECOPD mortality (AUROCDECAF < AUROCBAP-65 < AUROCModified DECAF). Although all three scores are statistically significant in predicting theprognosis of patients hospitalized with AECOPD (Fig 7).

Figure 7: Roc Curve for Mortality



Use of Mechanical Ventilation & Prognostic Tools

In our study area under ROC curve for use of mechanical ventilation is highest for the modified DECAF score in comparison to the other two scores (Fig 8).



Discussion

Hospitalization for Acute exacerbation is recognized as a major event in the natural history of chronic obstructive pulmonary disease due to its negative impact on lung function, disease progression, survival, rate of hospitalization, and quality of life. Identifying patients at high risk of death or readmission during an episode of severe exacerbation of COPD may enable more optimal use of available resources and may help to identify patients with very poor prognosis, in whom supportive care is perhaps more appropriate and useful.[8]Mortality rate increases with increasing BAP-65 score, which has statistically significant association based on the Chi-square test ($\chi 2$: 48.350), with a P-value = 0.000. The mortality rate was zero in patients with BAP-65 class 1-2,while it was increasing at 3.4%, 20% and 60% from class 3 to 5.Out of 92 patients studied, 33 patients were in the low-risk group (DECAF score 0-1) with no mortality, 23 patients were in the intermediate-risk group (score 2) with 8.7% mortality and 36 patients were in the high-risk group (score 3-6) with 30.5% mortality rate. Various studies show little variation of in-hospital mortality rates in different risk groups of DECAF score but certainly higher the DECAF score, higher is the mortality and this relation is statistically significant at p=0.000.The findings by J Steer et al [6], showed that in DECAF score 0-1 the in-hospital mortality was 1.4%, in score 2 mortality was 8.4% and in score 3-6 the mortality was 34.6%. Ramadan Nafae et al,[9] studied in-hospital mortality rates according to each grade of the DECAF score with relevant sensitivity and specificity: DECAF 0–1 ('low risk'; in-hospital mortality = 3.37%); DECAF 2 ('moderate risk'; mortality = 7.7%); and DECAF 3–6 ('high risk'; mortality = 37%). C Echevarria et al,[10] also found significant relationship (p<0.0001) between in-hospital mortality and DECAF score.Out of 92 patients studied, 33 patients had modified DECAF score between 0-1 (low risk), 20 patients had a score of 2 (intermediate risk) with no mortality in either group, whereas 33.3% (13/39) patients had mortality in the high-risk group, scoring between 3-6, although all patients with in-hospital mortality (n=13) attained a score (3-6) of high-risk group, which is statistically significant at p=0.000. In a study done by Hitesh Kumar Bansal et al,[11] they observed 2.17% mortality rate in the low-risk group (score 0-1), 7.84% in Moderate (score 2) and 46.6% in the high-risk group (score 3-6) according to modified DECAF score. The higher mortality rate in their study could be due to the higher percentage of patients having consolidation and frequent admissions during last year, as both factors significantly affect the in-hospital mortality.Zidan MH et al,[7]and Prakash et al[12] also found the significant values (p < 0.001) between the Modified DECAF score and mortality due to AECOPD and concluded that Modified DECAF score is a powerful score to predict in-hospital mortality due to AECOPD.Out of the 92 patients, 13 patients (14.1%) needed mechanical ventilation. As the BAP-65 score increases the use of mechanical ventilation increases significantly (3.4% in class 3 v/s 53.3% in class 5).As the DECAF score increases the use of mechanical ventilation increases. In the low-risk group, no patient was ventilated. In the intermediate-risk group, 8.7% of patients and in high-risk group 30.6% of patients were ventilated. By the chi-square test, there is a significant association between the DECAF score and the use of mechanical ventilation, at P=0.000. Sangwan V et al[13] and Ravi Chethan Kumar A. N et al [14] observed in their studies that patients with high DECAF score require mechanical ventilation compared to lower scores, this finding is comparable to present study. On analyzing ventilated patients according to modified DECAF score, only high-risk group patients needed mechanical ventilation with significant association at $\chi2$=33.073, p=0.000.In our cohort, we found that Modified DECAF score has more sensitivity and specificity in predicting in-hospital mortality in AECOPD patients than both the DECAF and BAP-65 scores. The BAP-65 score obtained the area under receiver-operating characteristic curve (AUROC) of 0.907 with Standard Error: 0.037, 95% confidence interval [CI] 0.834 to 0.981. The DECAF score has an AUROC of 0.859, Standard Error: 0.049, 95% confidence interval [CI] 0.763 to 0.955. The AUROC of Modified DECAF score is 0.924, Standard Error: 0.031, 95% confidence interval [CI] 0.864 to 0.984, P-value:0.000. M. Yousif et al[15] and V. Sangwan et al[13] also found the greater AUROC for BAP-65 score than the DECAF score which is in line with our results but the former also observed the higher AUROC for BAP-65 score than the modified DECAF score which is against our observations.The AUROC for use of mechanical ventilation demostrates higher accuracy for modified DECAF score rather than the other two scores. AUROCDECAF =0.875, v/s AUROCModified DECAF =0.914, v/s AUROCBAP-65=0.893, p- value 0.000).The indices of BAP-65 score correlate well with mortality and MV need in AECOPD patients as BUN reflects intravascular volume depletion (due to decreased oral intake and hyperventilation prior to admission), tachycardia reflects the volume status of the patient, and the degree of hypoxemia, also it may correlate with the general distress of the patient, Finally, a decrease in mental status is a better predictor of the underlying pathophysiologic mechanisms of hypercapnia in AECOPD than direct measurement of the partial pressure of carbon dioxide, because some patients with chronic respiratory failure tolerate high levels of $PaCO_2$ well, without showing any clinical disturbance.[16]Thus the BAP-65 is the simplest model among the rest and the quickest to be calculated. We only need the history and physical examination with the BUN level to calculate the BAP, but we need more laboratory tests and imaging in order to calculate the other scores (CBC/AEC, ABGs, ECG, CXR…). This also raises the issue of cost/effectiveness and time-consumption, since these tests are costly and need time to be completed.The degree of dyspnea can be measured on a scale (eMRCD scoring system). It is also more responsive than FEV1 in tracking changes of health status in COPD and has been recommended as the preferred marker of COPD severity over FEV1 in the Canadian Thoracic Society COPD clinical practice guidelines.[17] As dyspnea is a subjective feeling, minor variation in grading can be observed which may affect the scoring with respect to outcome. Eosinopenia is a common inflammatory response to acute infection (first reported by Zappert et al [18]) and useful marker of severity in patients admitted with AECOPD independent of the total WBC count and pH. Other high-risk comorbid conditions like consolidation, hypercapnic acidosis, and atrial fibrillation in AECOPD patients have been documented to have a firm association with high risk of intensive care admission and mortality. Most of the predictors in the DECAF score make sense as to why they might predict mortality in AECOPD, meaning they carry ‘‘face validity’’ and they are largely objective and reliable. However Bansal et al[11] and Zidan et al[7] found that atrial fibrillation was not associated with higher mortality.Patients with frequent exacerbations have an increased bacterial load in their airways in the stable state which is associated with increased airway inflammation and an accelerated decrease in FEV1, an indirect but potent mortality indicator. Furthermore, the stress of recurrent admissions may have a psychological impact and can turn into a decline in patient’s mental and physical health, slowing down their long term recovery, well-being and quality of life.Zidan et al[7] and Hurst et al[19] also demonstrated the frequency of admission to be the most linked factor to mortality after AECOPD. So the modified DECAF score appears to be the most sensitive and specific tool for predicting in-hospital mortality.

Conclusion

The present study shows that in patients admitted with acute exacerbation of COPD, the modified DECAF score, comprising of five variables – Dyspnea, Eosinopenia, Consolidation, Acidemia, frequency of admissions can strongly predict the in-hospital prognosis of patients. Higher the modified DECAF score, the higher is the mortality and higher is the need for mechanical ventilation.

Modified DECAF score has better prognostic sensitivity and specificity in predicting in-hospital mortality and the need for mechanical ventilation than both the DECAF and BAP-65 scores.

In the climax, remember that none of the prediction scores is infallible. The scoring system should not replace the clinical sense of the treating clinician. It is here to facilitate risk stratification and the appropriate extent of therapeutic intervention of the patients presenting with AECOPD.

Limitations

1. DECAF score derivation and validation was multi-central and on a larger population, whereas our study data is confined to a limited number of patients from a single center.
2. All the prognostic scores derived for AECOPD patients are not compared in this study.

Abbreviations

COPD: Chronic Obstructive Pulmonary Disease, AECOPD: Acute Exacerbation of Chronic, Obstructive Pulmonary Disease, DECAF: Dyspnea, Eosinopenia, Consolidation, Acidemia, Fibrillation. eMRCD: Extended Medical Research Council Dyspnea Score, FEV1: Forced Expiratory Volume in one second, ICU: Intesive Care Unit, CURB-65: Confusion, urea >7 mmol/L, Respiratory rate ≥30, Blood pressure (Systolic BP ≤ 90 mmHg, diastolic BP ≤ 60 mmHg), Age >65 years, APACHE: Acute Physiologic Assessment And Chronic Health Evaluation (score), AUROC: Area Under Receiver Operating Characteristic curve.

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