Assessment of Nutritional Status in Chronic Obstructive Pulmonary Disease Patients

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ABSTRACT

Introduction: Weight loss, muscle and fat mass depletion are common nutritional problems in COPD patients and are determinant factors in pulmonary function, health status, disability and mortality. We aimed to investigate the nutritional status of COPD patient with Body Mass Index (BMI), Subjective Global Assessment (SGA) and Mini Nutritional Assessment (MNA) and compare the correlation of SGA and MNA values with airflow limitation, BMI and anthropometric values.

Material and Methods: The total of 102 spirometry proven COPD patients between age 40 to 80 years were included in the study. The patients with other co-morbid condition that could affect nutritional status (diabetes mellitus, thyroid problems, congestive heart failure, cancer) and pregnant females were excluded. Anthropometric measures, biochemical parameters, Subjective Global Assessment and Mini Nutritional Assessment score were used for nutritional assessment.

Result: Mean percentage fat free mass levels showed an increasing trend with increasing stage of COPD and it was significant statistically ($p<0.001$). With increasing severity of COPD a significant decrease in mean MNA and BMI levels and a significant increase in mean SGA values was observed ($p<0.001$). Nutritional status in study population worsen with increasing severity of COPD stage as assessed by BMI ($p<.001$), SGA ($p<.001$) and MNA ($p<.001$). With increasing severity of malnutrition a significant and negative change in mean BMI was observed ($p<0.001$). Thus showing an inverse correlation between BMI and SGA-scores ($r=-0.713$; $p<0.001$).

Conclusion: mean %fat level, mid arm circumference, mid-calf circumference, mean MNA score, BMI, mean serum protein, albumin and mean lipid level decreases with increasing severity of COPD.

Keywords: Nutritional Status, Chronic Obstructive Pulmonary Disease, Body Mass Index, Mid Arm Circumference, Subjective Global Assessment (SGA) and Mini Nutritional Assessment (MNA).

INTRODUCTION

Chronic Obstructive Pulmonary Disease is characterised by progressive irreversible air flow limitation, which is preventable and treatable. It is associated with an enhanced chronic inflammatory response in airway and the lung to noxious particles or gases.[1] Its prevalence is 5% amongst Indian males and approximately 3.2% among Indian females over 35 years of age. COPD is responsible for significant morbidity and mortality. The projection for 2020 indicates that COPD will be the 3rd leading cause of death worldwide and 5th leading cause of year loss through early mortality or handicap in terms of disability adjusted life year (DALY). Malnutrition is a very common, frequently unrecognised and neglected in COPD patients. Nutritional status disorder pose a serious problem and multiple factors are responsible for malnutrition, which is a concern in about 20% of COPD patients.[2] So, early diagnosis of malnutrition is important. Despite this large magnitude very few studies had addressed this problem. To measure malnutrition we need history taking, the evaluation of the dietary intake, body mass index, anthropometric measures (triceps skin fold thickness, mid-arm muscle circumference), serum proteins (albumin, transferrin, serum cholesterol), free fat mass index, dexa scan and screening tests (Subjective global assessment, Mininutritional assessment). So by proper nutritional assessment we can intervene the progression of severity of COPD. We aimed to investigate the nutritional status of COPD patient with Body Mass Index (BMI), Subjective Global Assessment (SGA) and Mini Nutritional Assessment (MNA) and compare the correlation of SGA and MNA values with airflow limitation, BMI and anthropometric values

MATERIAL AND METHODS

The study was done over a period of 1 year in a tertiary care centre in northern India. The study group was consist of male and female patients age more than 40 years and less than 80 years, diagnosed to have COPD by spirometry and given the consent for participation in the study. Severity of these patients was determined according to GOLD classification criteria. Exclusion criteria:-The patients with any other co-morbid condition that could affect nutritional status (thyroid problems, diabetes mellitus, cancer, congestive heart failure, pregnant female and patient's not giving consent were excluded from the study. For this purpose, a total of 102 spirometry proven COPD patients were taken and they were evaluated on basis of clinical history, anthropometric measure (weight, height, mid arm circumference, supra iliac skinfold thickness), lab parameter [haemoglobin, s. protein, s. albumin, lipid profile, fasting iron profile, thyroid function test (T3,T4,TSH) and RBS]. Based on these parameter their Subjective Global Assessment and Mini Nutritional Assessment score were calculated.

STATISTICAL ANALYSIS

SPSS version 21 was used for the statistical analysis. Chi square test was used for the comparison of variables. Descriptive

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SN	Variable	Stage I (n=18)	Stage II (n=30)	Stage III (n=45)	Stage IV (n=9)	Statistical significance	
		Mean±SD	Mean±SD	Mean±SD	Mean±SD	F	P
1.	% Fat levels	19.89±2.47	17.43±2.03	16.71± 2.05	15.44± 1.33	F=12.927	<0.001
2.	% Fat Free Mass	80.11±2.47	82.57±2.03	83.29±2.05	84.56±1.33	F=12.927	<0.001
3.	MCC	32.91.2	30.0±1.8	28.5±1.6	27.2±1.2	F=42.97	<0.001
4.	MAC	23.1±1.6	20.0±1.7	19.5±1.3	18.1±1.3	F=32.53	<0.001
5.	MNA	23.3±2.3	18.9±2.8	16.6±1.9	14.7±1.5	47.09	<0.001
6.	SGA	13.3±2.6	26.9±8.6	34.7±7.5	40.3±3.7	48.63	<0.001
7.	BMI (kg/m^2)	24.3±1.9	18.8±1.7	17.4±1.6	16.2±1.6	84.67	<0.001

Table-1: Correlation of COPD severity with % fat levels, % fat free mass levels, mid calf circumference and mid arm circumference, MNA, SGA scores and BMI

Sr No	Variable	Stage I (n=18)	Stage II (n=30)	Stage III (n=45)	Stage IV (n=9)	Statistical significance	
		Mean±SD	Mean±SD	Mean±SD	Mean±SD	F	P
1.	S. Protein	6.8±0.4	6.2±0.5	6.0±0.4	5.8±0.3	14.52	<0.001
2.	S. Albumin	3.7±0.4	3.2±0.6	2.9±0.6	2.6±0.4	13.77	<0.001
3.	S. Ferritin (ng/ml)	115.7±52.1	107.9±41.0	122.0±54.6	148.4±109.8	1.225	0.305
4.	S. TIBC (µg/dl)	190.6±46.9	199.3±53.0	220.8±102.6	271.9±80.3	2.507	0.063
5.	S. Iron (µg/dl)	76.4±18.6	64.5±25.9	66.7±24.9	62.6±17.2	1.153	0.332
6.	TG	140.3±6.4	138.0±16.3	117.6±11.1	98.3±5.5	42.00	<0.001
7.	LDL	115.9±8.3	117.5±6.4	112.9±5.4	95.9±4.0	29.57	<0.001
8.	HDL	47.6±7.2	40.9±4.6	37.6±1.7	33.1±1.3	34.99	<0.001
9.	TC	191.6±9.1	186.0±10.1	174.0±5.9	148.7±4.9	73.40	<0.001

Table-2: Relation of COPD severity with S. Protein, Albumin, Ferritin, TIBC, S. iron and fasting lipid profile levels

Variables	"r"	"p"
S. Protein and FEV_1(%)	0.569	<0.001
S. Protein and FEV_1/FVC	0.013	0.896
S. Albumin and FEV_1(%)	0.554	<0.001
S. Albumin and FEV_1/FVC	0.008	0.933
S. Ferritin and FEV_1(%)	-0.092	0.357
S. Ferritin and FEV_1/FVC	0.110	0.271

Table-3: Correlations

statistics was used for the inferential data.

RESULTS

This study was carried out with an aim to assess the nutritional status of Chronic Obstructive Pulmonary Disease (COPD) patients. A total of 120 COPD patients were enrolled in the study. Out of 102 17.6% patients were in COPD stage I, 29.4% in stage II, 44.1% in stage III and remaining 8.8% in stage IV. Majority of patients irrespective of stage were males. Though proportion of males was lower in Stage I (66.7%) as compared to stages II to IV (73.3% to 83.3%) yet this difference was not significant statistically (p=0.595). Male and female ratio in our study population was 3.2. Irrespective of the stage of disease, majority of patients were aged <60 years. Mean age of patients was minimum in Stage II (55.73±8.77 years) and maximum in Stage I (59.33±10.40 years). Statistically, there was no significant association between age and COPD stage (p>0.05). Statistically, a significant association between smoking status and COPD stage was observed (p=0.025). With increasing COPD stage proportion of patients with smoking habit showed a significant increase. (p=0.025). Mean fat free mass (%) was 82.70±2.38 in males and 82.40±2.57 in females. This difference was not significant statistically (p=0.591). Mean % fat levels showed a declining trend with increasing stage of COPD and this association was statistically significant (p<0.001).

Mean % fat free mass levels showed an increasing trend with increasing stage of COPD and this was also significant statistically. Mean arm circumference and Mean calf circumference showed a significant decline with increasing severity of COPD (p<0.001). A significant decrease in mean MNA and BMI levels were observed with increasing stage of COPD whereas a significant increase in mean SGA values were observed with increasing stage of COPD (p<0.001). Their correlation with COPD severity is illustrated in Table 1.

A significant decrease in mean serum protein and albumin levels were observed with increasing stage of COPD (p<0.001). Mean S. ferritin levels ranged from 107.9±41.0 ng/ml (Stage II) to 148.4±109.8 ng/ml (Stage IV). Statistically, no significant association was seen between S. ferritin levels and COPD severity (p=0.305). Mean S. TIBC levels showed an increasing trend with increasing stage of COPD, however, this association was not significant statistically (p=0.063). Mean S. Iron levels ranged from 62.6±17.2 µg/dl (Stage IV) to 76.4±18.6 µg/dl (Stage I). Statistically, no significant association was seen between S. Iron levels and COPD severity (p=0.332). With increasing severity of COPD a significant decrease in mean lipid levels was observed (p<0.001) (Table 2).

A moderate and significant positive correlation of S. protein and S. albumin levels were observed with FEV_1 (%). However, correlation of S. protein with FEV_1/FVC, S. ferritin with FEV_1 (%) and S. ferritin with FEV_1/FVC was weak and was not found to be significant (r<0.3; p>0.05) (Table 3).

DISCUSSION

The study helped us in various aspects and gives us information about multiple factors involved in assessment of nutritional status in COPD patients. Statistically, a significant association

between smoking status and COPD stage was observed (p=0.025). With increasing COPD stage, proportion of patients with smoking habit showed a significant increase. Au DH, et al studied that ex-smokers had a significantly reduced risk of COPD exacerbation after adjusting for age, comorbidity, markers of COPD severity and socio-economic status in comparison to current smokers. Smoking cessation is associated with a reduced risk of COPD exacerbations, and reduction is dependent upon the duration of abstinence.[3]

Mean percentage fat levels showed a declining trend whereas mean percentage fat free mass levels showed inclining trends with increasing stage of COPD and both are having statistically significant association with COPD stages (p<0.001). Significant decrease of fat mass in our study which is observed among disease stages may be related to factors like anorexia, early satiety and dyspnoea during eating. Mid arm circumference and mid-calf circumference showed a significant decline with increasing severity of COPD (p<0.001). Muscle wasting increased with progression of disease. It may be due to accelerated muscle proteolysis, hormonal dysfunction and increased level of cytokine.

Wijnhoven et al in their study showed that mortality rates were 599 of 826 (73%) in men and 479 of 841 (57%) in women. Based on the stronger association with mortality and given a more easy assessment in older persons, mid-upper arm circumference seems a more feasible and valid anthropometric measure of thinness than body mass index in older men and women.[4] With increasing severity of COPD there was a significant decrease in mean MNA and BMI levels and a significant increase in mean SGA values was observed (p<0.001). Nutritional status in study population worsen with increasing severity of COPD stage as assessed by BMI (p<.001), SGA (p<.001) and MNA (p<.001).

Gupta B, et al had studied on a total of 106 hospitalised patients with COPD. Out of 106 patients malnourishment was found in 83%. According to SGA score they were classified as well nourished (17%), moderately malnourished (59.5%) and severely malnourished (23.5%). SGA score had positive correlation with pulmonary function parameters and negative with anthropocentric parameters. However there was no correlation with biochemical parameters.[5]

King D et al. observed that underweight is a poor prognostic sign in chronic obstructive pulmonary disease (COPD) is at least in part associated with the severity of airflow obstruction. Nutritional supplementation in undernourished patients with COPD can lead to weight gain and improvements in respiratory muscle function and exercise performance.[6]

In a study perform by Yuceege MB, et al on 60 out patients of COPD without comorbidity they found that malnutrition leads to increased hospital admission. Malnutrition rate (according to BMI) was related with the COPD severity: 10% in mild, 13% moderate, 35% severe and 23.3% in very severe COPD. MNA identified more patients as malnutritoned than SGA (65% versus 41.7%).[7]

Sabino PG, et al had observed that overweight/obese patients had a higher fat-free mass (FFM) index, exercise capacity and maximal inspiratory pressure in comparison to normal weight and underweight patients, respectively.[8]

Leila Y, et al had done cross-sectional study on 63 COPD patients with mean age (SD) of 67.6 (9.4) years. In their study reduction of body mass index (BMI), Mid-Arm Muscle Circumference (MAMC) and Fat-Free Mass (FFM) were observed alongside an increase in disease severity but it was not significant. Significant reduction of Fat Mass (FM) (P= 0.007), Fat Mass Index (FMI) (P= 0.03) and biochemical indices like albumin (P= 0.001) and total protein (P= 0.04) were associated with an increase in disease stages. Nutritional status indices like MAMC, FFM and FM, other than BMI should be used for early diagnosis of malnutrition before weight loss occurs.[9]

Marquis and colleagues showed that among 142 patients with COPD, FEV_1 and mid-thigh cross-sectional area by CT scan were independent and additive predictors of mortality. FFM, estimated anthropometrically, failed to predict mortality, showing that nutritional status assessed from precise measurements of FFM is more sensitive than anthropometry in reflecting the true nutritional deficit in COPD. Other studies have examined the relationship between nutritional status and long-term outcome in COPD using the easily available metrics of weight and BMI.[10] Landbo and coworkers studied a cohort of 2,132 patients with COPD in which, they found increased mortality in patients with low BMI compared with subjects of normal weight. The risk of death relative to patients with BMI over 30 kg/m^2 was 1.4 for BMI 25 to 29 kg/m^2, 1.8 for BMI 20 to 24 kg/m^2, and 2.4 for BMI less than 20 kg/m^2.[11]

In the IPPB trial, Wilson DO and coworkers demonstrated a correlation between decreasing body weight and mortality. However, this relationship did not reach statistical significance in the most severely obstructed patients (FEV_1 < 35% predicted).[12] Yılmaz D et al. had studied on 65 male moderate-to-severe stable COPD patients. Of which 13.8% patients were underweight (BMI < 21 kg/m2) and 18.5% had a low fat-free mass index (FFMI < 16 kg/m2). Patients with normal FFMI had significantly higher weight, height, WC, MUAC, handgrip strength, fat and fat-free mass than the patients with low FFMI (for all; p < 0.05).[13]

In our study significant decrease in mean serum protein and albumin levels was observed with increasing stage of COPD (p<0.001). However, no significant association was found with serum iron, ferritin and TIBC (p>0.05). The lower mean of albumin and total protein may be due to malnutrition or inflammation. In a study by Chen C et al, out of 42,732 newly diagnosed COPD patients, 5,248 patients (12.3%) developed acute respiratory failure during the 6 years follow-up period. Patients with hypoalbuminemia were older, predominantly male, had more comorbidities, and required more steroid treatment and blood transfusions than patients without hypoalbuminemia. In a multivariable Cox regression analysis model, being elderly was the strongest independent risk factor for acute respiratory failure followed by hypoalbuminemia. Therefore, further prospective studies are required to verify whether or not albumin supplementation or nutritional support may help to reduce the risk of acute respiratory failure in patients with COPD.[14]

Mean S. ferritin levels ranged from 107.9±41.0 ng/ml (Stage II) to 148.4±109.8 ng/ml (Stage IV). Statistically, no significant association was seen between S. ferritin levels and COPD severity (p=0.305). Mean S. TIBC levels showed an increasing trend with increasing stage of COPD, however, this association was not significant statistically (p=0.063). Mean S. Iron levels ranged from 62.6±17.2 µg/dl (Stage IV) to 76.4±18.6 µg/

dl (Stage I). Statistically, no significant association was seen between S. Iron levels and COPD severity (p=0.332). S.ferittin arise from cell leakage. It is also a marker of oxidative stress and hydroxyl radicle formation. Silverberg DS, et al studied anemia and iron deficiency in hospitalized COPD patients: out of 107 consecutive patients hospitalized with an acute exacerbation of COPD, 47 (43.9%) were found to be anemic on admission. Two (3.3%) of the 60 non-anemic patients and 18 (38.3%) of the 47 anemic patients had serum iron, percent transferrin saturation (%T sat) and serum ferritin measured. All 18 (100%) anemic patients had ID, yet none had oral or IV iron subscribed before or during hospitalization, or at discharge. ID is common in COPD patients but is rarely looked for or treated. Correction of the ID in COPD patients can improve the anemia, the ID, and may improve the dyspnoea.[15]

With increasing severity of COPD a significant decrease in mean lipid levels was observed (p<0.001) in our study. However in a study by Nillawar, AN et al, they had not found any statistical difference in the lipid profile in the two groups.[16]

Limitations of our study are as follows

This was a single centre study and the number of subjects enrolled in our study were small. Hence, large scale validation is needed. In this study, staging of COPD was made by an older version of GOLD guideline, by spirometry finding alone.

CONCLUSION

Assessment of the nutritional status in COPD is a vital step in management of COPD patients. Planning what we eat and balancing our meals help us to manage our health. Good nutrition helps the body fight infections by strengthening our immunity. Assessment of nutrition and filling of lacuna will not cure COPD but will surely postpone the associated comorbidity. Physicians should aware of different methods that can be used for nutritional assessment. Hence the role of dieticians should be incorporated in order to evaluate the nutritional intake and thereby plan the diet of patients at every stage of COPD to improve the disease prognosis.

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