International Journal of Advances in Medicine
Toppo A et al. Int J Adv Med. 2017 Apr;4(2):450-456
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: http://dx.doi.org/10.18203/2349-3933.ijam20171040

Original Research Article

A study to assess nutritional profile in chronic obstructive pulmonary disease patients

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Received: 13 January 2017
Accepted: 17 February 2017

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ABSTRACT

Background: The potential ill effects of malnutrition are numerous, such as decreased maximal respiratory muscle force, decreased hypoxic Ventilatory response and decreased resistance to infection. The objective was to assess nutritional profile in chronic obstructive pulmonary disease (COPD) patient.
Methods: The study was conducted at a tertiary care referral hospital. Period of study was one year. Present study was case control study. Institutional Ethics committee permission was taken. A total of 75 cases of chronic obstructive pulmonary disease and comparable controls were included in the study.
Results: Present study shows that there was significant difference in mid arm circumference and mid-thigh circumference between COPD cases and control groups as well as between serum pre-albumin and serum transferrin level, serum uric acid (p=0.018) and serum calcium level (p=0.002). There was no statistically difference with respect to serum total protein (p=0.308), serum albumin (p=0.533) and serum phosphorus level (p=0.064) between COPD patient and control groups. There was statistically significant difference in total lymphocyte count between COPD cases and control groups as well as between serum LDL and serum HDL, serum LDL and serum HDL with COPD grading. As COPD grading increased there was significant decrease in serum LDL and serum HDL level. There was no significant difference with respect serum TG (p=0.738), VLDL and total cholesterol level (p=0.063) between COPD cases and control groups.
Conclusions: Simple measurement of BMI, mid arm circumference and mid-thigh circumference can assess mal-nutrition in COPD patients and biochemical parameter like serum pre-albumin and serum transferrin may helpful in early detection of malnutrition.

Keywords: BMI, Mid arm circumference, Mid-thigh circumference

INTRODUCTION

The potential ill effects of malnutrition are numerous, such as decreased maximal respiratory muscle force, decreased hypoxic Ventilatory response and decreased resistance to infection.[1] Body weight and body mass index are useful screening tools in the initial nutritional evaluation, fat-free mass (FFM) may be a better marker of under nutrition in patients with COPD.[2] Active nutritional supplementation in undernourished patients with COPD can lead to weight gain and may lead to improvements in respiratory muscle function and exercise performance. This may be part of pulmonary rehabilitation program to increase respiratory function

and to live symptom free life.[3] COPD is characterized by a state of chronic illness.[4] So, COPD is no longer to be considered to affect only the lungs and airways but also the rest of the body.[4]

Thus we hypothesize that early detection of nutritional function in COPD patients and active intervention to correct the abnormalities may be helpful in correcting respiratory function and can be used as useful tool in pulmonary rehabilitation program for better management of COPD patients and active intervention can also prevent the further complication in COPD patients and thus may decrease the mortality and morbidity in COPD patients.

METHODS

The objective of the study was to assess the nutritional profile of patients with chronic obstructive pulmonary disease. The study was conducted at a tertiary care referral hospital. Period of study was one year. Present study was case control study. Institutional Ethics committee permission was taken. A total of 75 cases of chronic obstructive pulmonary disease and comparable controls were included in the study.

Inclusion criteria

Patients giving consent and age 18 to 75 years.

Exclusion criteria

COPD patients with family history of Diabetes mellitus, Known cases of congenital or acquired heart diseases, bronchial asthma, pulmonary tuberculosis, bronchiectasis, diabetes mellitus, hypertension & obesity, Patient taking any Anti-hyper lipidemic medications, Those not giving the consent, Non cooperative, Age less than 18 years and greater than 75 years.

Following evaluation was preformed

Liver and renal function test, complete blood count and differential leucocytes count, blood sugar, chest x ray, electrocardiogram and echocardiography (if required), Alpha 1 antitrypsin level (if required), Sputum for AFB, Serum protein, Serum pre-albumin, Serum transferrin, Serum uric acid, Serum calcium, Serum phosphorus, Total lipid profile.

GOLD classification of COPD on the basis of post bronchodilator FEV_1.

Classification of severity of airflow limitation in COPD.

In patients with FEV1/FVC<0.70

- GOLD I - Mild ($FEV_1 \geq 80\%$ predicted)
- GOLD II- Moderate ($50\% \leq FEV_1 < 80\%$ predicted)
- GOLD III- Severe ($30\% \leq FEV_1 < 50\%$ predicted)
- GOLD IV- Very severe ($FEV_1 < 30\%$ predicted)

Nutritional assessment was done through following parameter

Clinical assessment

Body mass index, mid- arm circumference, mid –thigh circumference, other sign of malnutrition (if present).

Biochemical assessment

Total serum protein, Serum albumin, Serum pre-albumin, Serum transferrin, total lymphocyte count, Haemoglobin, Serum calcium, Serum uric acid, Serum phosphorus, Total lipid profile

Statistical analysis

Data was recorded and entered. Student t test was used and p value of less than 0.05 was considered significant.

RESULTS

Above data shows highly statistically significant difference with respect to total lymphocyte count, serum pre-albumin levels and serum transferrin levels ($p<0.001$) and fair significant with respect to serum uric acid level (p value 0.018) and serum calcium level (p value 0.002) between COPD cases and control groups. There was no significant difference with respect to total protein (p value 0.308), serum albumin (p value 0.533) serum phosphorus (p value 0.064) and hemoglobin (p value 0.653) between COPD cases and control (Table 1).

Mean LDL was significantly (=0.002) higher in COPD cases. And fair statistically significant low HDL level was observed between COPD cases and control (p=0.016). No significant difference was seen with respect to serum triglyceride level (=0.738), serum VLDL level (p=0.495) and total cholesterol level (p=0.06) between COPD cases and control groups (Table 2).

There was no significant difference between COPD grading in regards with serum albumin level (p=0.27) and serum total protein level (p=0.38) (Table 3).

There was a significant difference between COPD grading with respect to serum pre-albumin level and serum transferrin level ($p<0.05$). Serum pre-albumin was significantly different between moderate to very severe COPD grade and rest is not significant between grades of COPD (Table 4).

There was no significant difference between total lymphocyte count (p=0.99) and hemoglobin levels (p=0.23) between different grades of COPD (Table 5).

Table 1: Biochemical assessment of nutritional profile in COPD cases and controls.

Variable	Group	N	Mean	Standard deviation	P value
Total protein (g/dl)	Cases	75	7.67	0.54	0.308
	Control	25	7.53	0.64	
Serum albumin (mg/dl)	Cases	75	3.62	0.62	0.533
	Control	25	3.71	0.78	
Total lymphocyte count (count /$mm^{3)}$	Cases	75	2748.41	679.97	<0.001
	Control	25	1739.60	543.05	
Serum pre-albumin (mg/dl)	Cases	75	15.56	3.71	<0.001
	Control	25	24.40	4.57	
Serum transferrin (mg/dl)	Cases	75	90.45	12.32	<0.001
	Control	25	127.20	8.48	
Serum uric acid (mg/dl)	Cases	75	3.44	0.85	0.018
	Control	25	2.99	0.66	
Serum calcium (mg/dl)	Cases	75	9.41	0.99	0.002
	Control	25	10.1	0.85	
Serum phosphorus (mg/dl)	Cases	75	4.05	1.18	0.064
	Control	25	4.84	3.09	
Haemoglobin (gm/dl)	Cases	25	12.93	6.35	0.653
	Control	75	12.36	1.43	

Table 2: Lipid profile wise distribution of COPD cases and controls.

Variable	Group	N	Mean	Standard deviation	P value
Triglyceride (mg/dl)	Cases	75	123.21	48.35	0.738
	Control	25	119.80	27.24	
LDL (mg/dl)	Cases	75	120.55	43.15	0.002
	Control	25	90.68	25.96	
HDL (mg/dl)	Cases	75	34.20	7.90	0.016
	Control	25	38.56	7.05	
VLDL (mg/dl)	Cases	75	23.87	9.78	0.495
	Control	25	25.31	6.75	
Total cholesterol (mg/dl)	Cases	75	177.29	55.93	0.063
	Control	25	155.48	26.32	

Table 3: Comparison between different grades of COPD cases as regard to biochemical assessment of serum total protein and serum albumin.

Variable	GOLD stage	N	Mean	Standard deviation	P value
Serum albumin (gm/dl)	II	25	3.676	0.617	0.27
	III	25	3.720	0.664	
	IV	25	3.452	0.581	
Serum total protein (gm/dl)	II	25	7.658	0.611	0.38
	III	25	7.708	0.621	
	IV	25	7.672	0.414	

Table 4: Comparison between different grades of COPD cases as regard to biochemical assessment of serum pre-albumin and serum transferrin.

Variable	GOLD stage	N	Mean	Standard deviation	P value	II versus III	II versus IV	III versus IV
Serum pre-albumin (mg/dl)	II	25	17.16	3.375	0.019	NS	S	NS
	III	25	15.20	2.708				
	IV	25	14.32	4.394				
Serum transferrin (mg/dl)	II	25	91.48	9.030	0.014	NS	NS	S
	III	25	85.00	13.13				
	IV	25	94.88	12.72				

Table 5: Comparison between different grades of COPD cases as regard to biochemical assessment of total lymphocyte count and hemoglobin.

Variable	GOLD stage	N	Mean	Standard deviation	P Value
Total lymphocyte count (count/mm^3)	II	25	2751.96	848.52	0.99
	III	25	2750.16	612.54	
	IV	25	2743.12	574.76	
Hemoglobin (gm %)	II	25	12.58	1.09	0.23
	III	25	14.62	1.07	
	IV	25	11.60	1.56	

There was no significant difference within the grades of COPD with respect to serum uric acid level (p = 0.56), serum calcium level (p=0.27) and serum phosphorus levels (p=0.75) (Table 6).

There was significant difference between COPD grading with respect to LDL, HDL and total cholesterol level (p<0.05). And there was no significant difference with respect to VLDL (p value 0.802) and triglyceride level (p value 0.896) with grading of COPD patients (Table 7).

Significant negative correlation between the COPD grading and mid arm circumference (MAC) and mid thigh circumference (MTC), r = -0.334, p = 0.003, r = -0.329 n= 75 p =0.004 respectively. Overall, there was a strong, negative correlation between COPD grade to MAC and MTC. With Increases in COPD grading was correlated with decrease in MAC and MTC in COPD patients. But there was no statistically significant correlation between COPD grading and BMI (Table 8).

There was a significant negative correlation between the COPD grading and serum pre-albumin, r = -0.315, n= 75, p=0.006. Overall, there was a strong, negative correlation between COPD grade and pre-albumin. With Increases in COPD grade was correlated with decrease in pre-albumin level in COPD patient. But there was no statistically significant correlation between COPD grading and total protein, serum albumin and transferrin level in COPD patients (Table 9).

Table 6: Comparison between different grade of COPD cases as regard biochemical assessment of serum uric acid, serum calcium and serum phosphorus.

Variable	GOLD stage	N	Mean	Standard deviation	P value
Serum uric acid (mg/dl)	II	25	3.44	0.895	0.56
	III	25	3.59	0.896	
	IV	25	3.28	0.747	
Serum calcium (mg/dl)	II	25	9.54	0.79	0.27
	III	25	9.15	0.86	
	IV	25	9.53	1.26	
Serum phosphorus (mg/dl)	II	25	3.90	0.63	0.75
	III	25	4.13	1.78	
	IV	25	4.05	0.82	

Table 7: Comparison between different grades of COPD cases as regard to biochemical assessment of lipid profile.

Variable	GOLD stage	N	Mean	SD	P Value	II versus III	II versus IV	III versus IV
TG (mg/dl)	II	25	126.64	62.58	0.896	NS	NS	NS
	III	25	120.20	47.16				
	IV	25	122.80	32.38				
LDL (mg/dl)	II	25	141.88	63.86	0.009	S	S	NS
	III	25	109.72	19.40				
	IV	25	110.04	24.02				
HDL (mg/dl)	II	25	36.92	7.12	0.045	S	NS	NS
	III	25	34.28	9.30				
	IV	25	31.40	6.28				
VLDL (mg/dl)	II	25	24.36	12.79	0.802	NS	NS	NS
	III	25	22.79	8.98				
	IV	25	24.44	7.01				
Total cholesterol (mg/dl)	II	25	205.12	83.28	0.008	S	S	NS
	III	25	164.68	25.14				
	IV	25	162.08	29.42				

Table 8: Correlation between COPD grade and clinical assessment.

	BMI	MAC	MTC
N	75	75	75
R value	-0.180	-0.334	-0.329
P value	0.123	0.003	0.004
Significance	NS	S	S

There was a significant negative correlation between the COPD grading and serum total cholesterol, LDL and HDL levels, r = -0.316, p = 0.006, r =-0.303 p=0.008, r=-0.287 p=0.013 respectively. Overall, there was a strong, negative correlation between COPD grade and total cholesterol, LDL and HDL level. With Increases in COPD grade was correlated with decrease in total cholesterol and LDL and HDL level in COPD patients. But there was no statistically significant correlation between COPD grading and TG and VLDL level in COPD patients (Table 10).

Table 9: Correlation between COPD grading and biochemical assessment.

	Total protein	Serum albumi	Serum pre-albumin	Serum transferrin
N	75	75	75	75
R value	-0.147	-0.005	-0.315	0.113
P value	0.207	0.964	0.006	0.333
Significanc	NS	NS	S	NS

Table 10: Correlation between COPD grade and serum lipid profile.

	TG	Total cholesterol	LDL	HDL	VLDL
N	75	75	75	75	75
R value	-0.033	-0.316	-0.303	-0.287	0.003
P value	0.781	0.006	0.008	0.013	0.978
Significance	NS	S	S	S	NS

DISCUSSION

In this study BMI shows significant difference between the cases and control groups. A significant decrease in BMI (p=0.015) was found in COPD cases group. There was significant difference observed between moderate to severe COPD but not between moderate to severe and severe to very severe COPD. BMI doesn't correlate with severity of disease. This is in agreement with Karadag F et al and Yumin Zhou et al.[5,6]

There was highly significant difference was seen in mid arm circumference between COPD cases and control group (p<0.001). But there was a significant difference between moderate to severe and very severe and no significance observed between severe to very severe group of COPD patients. There was a significant negative correlation in relation to the severities of disease (p= 0.003 and r = -0.334). Baccioglu et al observed that mid arm circumference, mid arm circumference area are significantly lower in COPD cases than control group (p<0.001) and no significant difference seen between the severities of disease. [7] Panda RK et al in 2015 observed that prevalence of under nutrition in COPD patient is (30/72) 41.6% based on body mass index (<18.5 kg/m^2) and 63.8% (46/72) based on mid-upper arm circumference (<24 cm). But the author has not taken age matched control group as it is a cross sectional study.[8]

Highly statistical significant decrease in mid-thigh circumference was seen between COPD case and control group (p<0.001). There was significant negative correlation in relation to severity of disease (p=0.004 and r = -0.334). In comparison to our study Marquis K et al showed similar results.[9] In a recent study done by Eduardo FM et al in 2014 observed that mid-thigh muscle area {Mid-thigh muscle area = mid-thigh circumference in cm* (0.314 *anterior thigh skin-fold in cm)^2/(4* 3.14)} was significantly low in COPD patients.[10]

There was no statistically significant difference seen in serum protein level between COPD cases and control group (p = 0.308). There was no significant difference seen between severities of disease. There was no significant correlation with severity of COPD grading. In comparison to our study, a recent Indian study has done by Agarwal et al in 2013 showed no significant difference in total protein level between COPD cases and control group. They also observed that there was no significant difference between severities of disease.[11]

There was no statistical significance seen in serum albumin levels between COPD cases and control group (p= 0.553). And no significant difference was seen between severities of disease. There was no significant correlation with severity of COPD grading. A similar study recently had done by Cingözler et al in 2014 showed no significant difference in serum albumin level in between COPD cases and control group.[12]

There was highly statistically significant increase seen in total lymphocyte count between COPD cases and control

group (p<0.001). No significant difference was seen between severities of disease. In various study done by Koch A et al, Hodge SJ et al observed similar to our finding.[13,14]

Significant decrease was seen in serum pre-albumin level between COPD case and control group (p<0.001). Significant difference was seen between moderate to very severe COPD. There was significant negative correlation in relation to severity of disease (p = 0.006 and r = -0.315). Itoh T et al in 2004 showed decrease in pre-albumin level in underweight individuals whose BMI <18 kg/m^2 which was significant with p value <0.01 and also significant with control group which is consistent to our finding of decrease pre-albumin level as most of patient with COPD has low BMI <18 kg/m^2 in our study group.[15] So pre-albumin can be used as an early indicator of malnutrition in COPD patients. But further study comparing serum carnitine level and serum pre-albumin is required to find which can be used as best indicator for malnutrition.

Significant decrease was seen in serum transferrin between COPD cases and control group as (p<0.001). Significant difference was seen between severe and very severe COPD according to severities of disease. There was no significant correlation to severity of COPD grading. A similar study done by Fiaccadori et al in 1994 showed significant decrease in serum transferrin level in COPD patients as compare to control group (p<0.001).[16]

Significant increase is seen in serum uric acid between COPD cases and control group as (p=0.018). No significant differences were seen between severities of disease. In a similar study done by Lopez IH et al in 2003 observed highly significant correlation between hypoxemia and uric acid levels in both stable and unstable COPD patients (p value<0.05), which is similar to our study but doesn't correlate with severity of disease.[17]

No statistical significance was seen in serum calcium and phosphorus between COPD case and control group. No significant differences were seen between severities of disease. In contrary to our study done by Fiaccadori et al observed hypophosphatemia in COPD patient with respiratory failure.[16]

TG showed no significant difference between the cases and control groups. Our study results correlates with the study results of Hosney H et al in 2012 which showed no statically significant difference in TG level among cases and control group.[18]

TC showed no significant difference between the cases and control groups**.** The results of our study doesn't correlate with study conducted by K Begum et al in 2010 which showed that TC concentration is statically significant in case group as compared with control group.[19]

HDL showed no significant difference between the cases and control groups**.** These findings are in accordance with study conducted by Attaran D et al in 2013 which showed that HDL concentration in COPD was significantly higher in cases as compared to control group.[20]

LDL shows significant difference between the cases and control groups. These findings are in accordance with Niranjan MR et al in 2011 where they found significant difference in LDL level in COPD case group and matched control group.[21]

VLDL shows no significant difference between the cases and control groups. In contrary, a study conducted by K Begum et al in 2010 showed that VLDL concentration in COPD patients was significantly higher than the controls (p = 0.001).[18]

Serum lipid TG, VLDL levels showed no statically significant difference in moderate (Grade II), severe (Grade III), very severe (Grade IV) (COPD according to GOLD criteria). Correlation of mean total cholesterol levels of patients with moderate, severe, very severe COPD was statically significant between moderate to severe and very severe but not between severe and very severe for both LDL and Total cholesterol level. To the best of our knowledge significance differences with severity of disease had not been well studied. Park et al in 2015 had demonstrated that there was significant increase in LDL and TG more for LDL cholesterol than TG.[22]

CONCLUSION

Simple measurement of BMI, mid arm circumference and mid-thigh circumference can assess mal-nutrition in COPD patients. For biochemical assessment serum pre-albumin may be used for early detection of nutritional abnormality in COPD patient. Serum transferrin can be used as alternative to serum pre-albumin for detection of nutritional abnormality in COPD patients

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Toppo A, Sudheer D, Rajawat GS, Kurian T. A study to assess nutritional profile in chronic obstructive pulmonary disease patients. Int J Adv Med 2017;4:450-6.