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Cognitive Assessment in Patient of Chronic Obstructive Pulmonary Disease

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Abstract: ***Backgrounds: Chronic obstructive pulmonary disease (COPD) is a complex, multisystem disorder. Traditional measures of disease severity, such as airflow limitation, are poor markers of relevant patient outcomes, largely because they do not reflect the multisystem nature of the disease. Identification, understanding, and assessment of all relevant co-morbidities in COPD are needed to better characterize the full clinical spectrum of the disease. Cognitive impairment is one such co-morbidity with an emerging clinical relevance. In present case control study we aimed to do Cognitive Assessment in Patient of Chronic Obstructive Pulmonary Disease compared to a matched referral control group without any disease. Among patients with established COPD, we evaluated the impact of disease severity and impairment of respiratory physiology on cognitive impairment. Staging of COPD was done according to Global Initiative for chronic obstructive Lung Disease (GOLD). Cognitive impairment was defined as a Mini mental State Exam (MMSE) score of <24 points. Aims and Objectives: To assess of cognitive function in a patients of COPD & Co-relation of cognitive function with Global Initiative for chronic obstructive Lung Disease (GOLD) staging. Results: This study comprise of 99 patients in Case group suffering from COPD and 99 patients in Control arm not suffering from COPD. In case and control group 30.3% were female while remaining 69.7% were male. Comparison of MMSE score in cases and control group revealed that mean score in Attention & calculation, recall and Language is significantly lower in case group compare to control group. Total MMSE score was also significantly lower in case group. MMSE core & PO2 were significantly positively correlated. MMSE score increases with increase in the PO2 value. MMSE score and PCO2 were significantly negatively correlated. MMSE score increases with decrease in the PCO2 value. Conclusion: The present study concludes that patient with chronic obstructive pulmonary disease have significant cognitive impairment compared to healthy controls. The present study concludes that hypoxaemia, hypercapnia, lung function, smoking and BMI are important risk factors for cognitive impairment in COPD patients. Cognitive impairment was very high in severe COPD GOLD stage compare to mild and moderate COPD.***

Keywords: Chronic obstructive pulmonary disease (COPD), Global Initiative for chronic obstructive Lung Disease (GOLD), Mini Mental status Examination (MMSE).

1. Introduction

Chronic obstructive pulmonary disease (COPD), a common medical ailment, results in significant morbidity and mortality. An estimated 9-10% of people around the globe suffer from the disease in both developed and less developed countries, and it ranks fourth among causes of death in the U.S. According to experts, it will become the third leading cause of death worldwide by 2020 as people continue to smoke and as the global population ages (Bellia et al.2003)[1].

COPD is characterized by airflow obstruction; its breath-related symptoms include wheezing, exertional dyspnea, chronic cough, and expectoration (Rennard, 1998)[2]. These symptoms, which may present in conjunction with hyper-responsiveness of the airway, are partly reversible.

WHO defines COPD as Chronic obstructive pulmonary disease (COPD)is a lung disease characterized by chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible[3]. Brain function may be adversely affected by COPD, and magnetic resonance imaging (MRI) has shown altered cerebral perfusion in patients with COPD who have cognitive dysfunction as a clinical manifestation[4]. The relationship between the many processes involved in an everyday cognitive task is complex, but cognitive ability is usually broken down into domains concerning memory, learning ability, attention/ concentration, abstract thinking, and problem solving[5]. Cognitive dysfunction reduces the level of functioning as assessed by activities of daily living[6] and it is associated with poor compliance with both medication and oxygen therapy, and poor compliance increases the risk of acute exacerbation[7].

Hypoxemia and hypercapnia appear to aggravate cognitive dysfunction in patients with COPD[8] and in a multicenter study of 302 patients with mild, moderate and severe hypoxia, the frequency of cognitive dysfunction was 27% in patients with mild hypoxia and 61% in patients suffering from severe hypoxia[9]. Increasing age and low level of education were also associated with cognitive impairment. Furthermore, a direct association between cerebral hypo-perfusion and cognitive dysfunction has been described. In addition, cognitive performance might also be affected in patients with normal oxygen saturation[10]. Several features of COPD may contribute to impaired cognitive function, including hypoxemia and co-morbid cardiovascular disease[11]. In addition, COPD may lead patients to curtail their physical activity which may, in turn, further increase the risk of cognitive Impairment[12].

The majority of the studies (62%) concerned patients over 40 yrs of age, in particular those aged between 40 and 64 yrs. The prevalence of COPD increases with age, with a five-fold increased risk for those aged over 65 yrs compared with patients aged less than 40 yrs[13].

Prevalence of COPD and it's association with smoking in various population studies from India[14].

	Population	COPD prevalence (%) Men	Women	M:F Ratio
Wig (1964)	Rural Delhi	3.36	2.54	1.3
Sikand (1965)	Delhi	7.0	4.3	1.6
Viswanathan (1966)	Patna	2.12	1.33	1.6
Bhattacharya (1975)	Rural UP	6.67	4.48	1.6
Radha (1977)	New Delhi	8.1	4.6	1.8
Thiruvengadam (1977)	Madras	1.9	1.2	1.6
Viswanathan (1977)	Delhi Rural	4.7	3.5	1.3
	Urban	8.0	4.3	1.9
Charan (1977)	Rural Punjab	2.28	1.63	1.4
Malik (1986)	N. India Rural	9.4	4.9	1.9
	Urban	3.7	1.6	2.3
Jindal (1993)	N. India Rural	6.2	3.9	1.6
	Urban	4.2	1.6	2.6
Ray (1995)	South India	4.08	2.55	1.6

One of the earliest studies to know the prevalence of COPD in India was carried out by Wig et al in 1964[15] in rural Delhi. The prevalence was 3.36 percent in males and 2.54 percent in females in this study. Viswanathan in 1966[16] reported 2.12 percent prevalence in males and 1.33 per cent in females in Patna. Radha and colleagues[17] noticed that the prevalence in New Delhi in 1977 was 8.1 percent in men and 4.6 percent in women. Jindal in 1993[18] reported that the prevalence was 6.2 percent in men and 3.9 percent in women in rural area, and 4.2 and 1.6 percent, respectively in urban area. All these studies were from north India and information from south India was scanty. Thiruvengadam et al in 1977[19] from Madras (south India) reported the prevalence of COPD of 1.9 percent in males and 1.2 percent in females. However, Ray et al in 1995[20] from south India found that the prevalence was 4.08 percent in males and 2.55 percent in females. Recently, the Indian Study on Epidemiology of Asthma, Respiratory Symptoms and Chronic Bronchitis in Adults (INSEARECH) involving a total of 85105 men, 84470 women from 12 urban and 11 rural sites was reported. This study had shown that the overall prevalence of chronic bronchitis in adults >35 yr was 3.49 percent (ranging 1.1% in Mumbai to 10% in Thiruvananthapuram). Thus there are wide variations in the prevalence of COPD in India subcontinent. Based on this study, the national burden of chronic bronchitis was estimated as 14.84 million.

The prevalence of COPD increases with age[21]. In the course of life, there is a physiological decline in respiratory function which begins around the age of 30–40 yrs. Because of the increase in life expectancy in developed countries, the proportion of older subjects with COPD also increases.

The hallmark of COPD is airflow obstruction[22]. Pulmonary function testing shows airflow obstruction with a reduction in FEV1 and FEV1/FVC. With worsening disease severity, lung volumes may increase, resulting in an increase in total lung capacity, functional residual capacity, and residual volume. In practice, Cognitive abilities are mainly inferred from behavior, which itself is determined by a wide variety of neurological, psychological and emotional factors[23]. A key mechanism proposed for cognitive dysfunction in COPD is neuronal damage mediated through hypoxia, but it has also been suggested that oxygen-dependant enzymes which are important in the synthesis of neurotransmitters, such as acetylcholine, may be affected[24].

Aims and Objectives

- Assessment of cognitive function in a patients of COPD
- Co-relation of cognitive function with Global Initiative for chronic obstructive Lung Disease (GOLD) staging.

2. Material and Methods

Study Setting

The present study was conducted in MGM Medical college & Hospital, Aurangabad, a tertiary care teaching hospital. The hospital mainly caters urban, peri urban and rural population of Aurangabad. This study was conducted among the COPD patients admitted to the hospital.

Study Type

The current study was a matched case control study. The eligible patients of COPD were form a Case group while controls were selected from the health individuals accompanying to patients in the hospital.

Study Period

The study took approximately two and half year to complete. Review literature and questionnaire preparation took approximately 12 months. The period of data collection was spread over 16 months after approval from the scientific and ethical Committee. More than 2 months required to data analysis and preparation of thesis report.

Sample Size

99 Cases of stable COPD patients
99 Healthy controls matched with age and sex of COPD patient.

Selection of Cases

All patients with respiratory complains admitted to the ward were investigated in detail to find out COPD. Those who were diagnosed having COPD were assessed for eligibility criteria. Patients fulfilling the [25] eligibility criteria were included in the study after consent. Eligibility criteria for cases were as follows:

Inclusion criteria:

All the patients of Chronic Obstructive Pulmonary Disease admitted in MGM Medical college & Hospital, Aurangabad; medically stable; and with at least primary school certificate.

Exclusion criteria:

COPD patients with Co existing any other significant systemic disease; medically unstable; and patient suffering from any psychiatric disorder.

Selection of Control:

Controls were selected after the selection of cases keeping ratio of 1:1 cases to control. Age and sex matched control were selected from the patients relatives accompanying to

the hospital. After the consent all control were investigated in detailed to rule out presence of COPD.

Data Collection

For all eligible cases and controls a predesigned questionnaire was used to record patients' data. Initially history taking was done to record socio-demographic and personnel information. The selected cases and controls were subjected to thorough clinical investigations with special references to respiratory system. For each specific symptom/ specific site a detailed history and relevant details was taken. All patients were assessed with spirometry and Staging was done according to Global Initiative for chronic obstructive Lung Disease (GOLD).

Statistical Analysis

It will be conducted using (SPSS) statistical packages for social science Version 18. Data will be represented using bar diagram, Pie diagram etc. Bivaried comparisons will be carried out using 't' test and chi square test for qualitative variables. We will try to use logistic regression to examine the association between COPD and the risk of cognitive impairment.

Ethical Consideration

As this study involve hospital patients which vulnerable group all care was taken to protect ethical rights of the patients. An approval was sought from the institutional ethical committee before the start of the study. For the eligible cases and controls were informed in detail about the study and it's process. They were also explained about probable benefits and potential risk associated with the study in vernacular language. Then after, a written consent was taken in vernacular language. A high degree of confidentiality was maintained at all level from recruitment to data collection to analysis.

3. Observations and Results

This study comprise of 99 patients in Case group suffering from COPD and 99 patients in Control arm not suffering from COPD. Following tables shows observation of the study.

Table 1:

There was no statistical difference in mean age of both the group ($p > 0.05$). BMI was lower in case group and this difference was statistically significant ($p < 0.05$).

Arterial blood gas analysis was carries out in all subjects of case and control groups. In cases mean PO_2 was 86.04 with standard deviation of 5.95 while mean PCO2 was 41.12 with standard deviation of 4.37. In control group mean PO_2 was 93.07 with standard deviation of 3.25 while mean PCO2 was 38.00 with standard deviation of 2.29.

Variables	Case (n=99)		Control (n=99)		P value
	Mean	SD	Mean	SD	
Age (in years)	56.88	9.20	56.92	9.19	0.975
BMI (kg/m^2)	21.34	3.07	22.22	2.53	0.029
PO_2	86.04	5.95	93.07	3.25	-
PCO_2	41.12	4.37	38.00	2.29	-

Table 2:

In case and control group 30.3% were female while remaining 69.7% were male. Distribution of male and female is equal in case and control group because controls were selected after matching sex and age. Observed value proportion of exposure to chulha smoke, smoking & cognitive impairment is much higher and this difference was statistically highly significant by using chi-square test. The calculated p value was less than 0.01.

Variables( )	Case		Control		Total	P value
	Freq	%	Freq	%		
(Sex)						
Male	30	30.3%	30	30.3%	60	1.000
Female	69	69.7%	69	69.7%	138	
Total	99	100%	99	100%	198	
(Smoking)						
Yes	69	69.7%	27	27.3%	96	0.001
No	30	30.3%	72	72.7%	102	
Total	99	100%	99	100%	198	
(Chulha smoke exposure)						
Yes	28	28.3%	10	10.1%	38	0.001
No	71	71.7%	89	89.9%	160	
Total	99	100%	99	100%	198	
(Cognitive impairment)						
Mild	11	11.1%	1	1%	12	0.003
No	88	88.9%	98	99%	186	
Total	99	100%	99	100%	198	

Table 3: All subjects including cases and controls were assessed for MMSE score. Comparison of MMSE score in cases and control group revealed that mean score in Attention & calculation, recall and Language is significantly lower in case group compare to control group. Total MMSE score was also significantly lower in case group. In orientation and registration there was no significant difference in case and control.

MMSE Score category	Case		Control		P value
	Mean	SD	Mean	SD	
Orientation	9.64	0.68	9.93	1.46	0.074
Registration	2.98	0.14	2.99	.10	0.536
Attention & Calculation	4.06	0.89	4.88	.33	< 0.001
Recall	2.22	0.60	2.85	.39	< 0.001
Language	8.68	0.60	8.83	.43	0.043
Total score	27.64	2.13	29.47	.99	< 0.001

Table 4: Except for Registration, MMSE score was significantly lower as the severity of COPD increases. He same was also reflected in total score. Total MMSE score decreased as the severity of COPD increases.

Cognitive functions MMSE Score	*GOLD Stage of COPD*						P value
	Mild (n=18)		*Mod (n=58)*		*Severe (n=23)*		
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	
Orientation	9.72	.83	9.79	.49	9.17	.78	.001
Registration	3.00	.00	2.98	.13	2.96	.21	.606
Attention & Calculation	4.61	.61	4.22	.77	3.22	.80	.000
Recall	2.67	.49	2.28	.52	1.74	.54	.000
Language	8.61	.70	8.83	.38	8.35	.83	.004
Total score	28.61	1.91	28.14	1.52	25.61	2.39	.000

Table 5: Proportion of male was 72.2% in mild COPD, 65.5% in moderate COPD and 78.3% in severe COPD. Thus proportion of male was higher in all three categories and it was nearly similar in all three categories. Proportions of subjects having exposure to chulha smoke were 16.7% in mild COPD, 34.5% in moderate COPD and 21.7% in severe COPD. Thus proportion of chulha smoke exposure was higher in moderate category followed by severe category. Proportion of smoker was 72.2% in mild COPD, 65.5% in moderate COPD and 78.3% in severe COPD. Thus proportion of male was higher in all three categories and it was nearly similar in all three categories. Mild cognitive impairment rate was 5.6% in mild COPD, 5.2% in moderate COPD and 30.4% in severe COPD. Thus cognitive impairment was very high in severe COPD GOLD stage compare to mild and moderate COPD.

Variables( )	GOLD Stage of COPD					
	Mild (n=18)		Mod (n=58)		Severe (n=23)	
	Freq	%	Freq	%	Freq	%
(Sex)						
Female	5	27.8%	20	34.5%	5	21.7%
Male	13	72.2%	38	65.5%	18	78.3%
Total	18	100%	58	100%	23	100%
(Chulha smoke exposure)						
Yes	3	16.7%	20	34.5%	5	21.7%
No	15	83.3%	38	65.5%	18	78.3%
Total	18	100%	58	100%	23	100%
(Smoker)						
Yes	13	72.2%	38	64.5%	18	78.3%
No	5	27.8%	20	35.5%	5	21.7%
Total	18	100%	58	100%	23	100%
(Cognitive impairment)						
Mild	1	5.6%	3	5.2%	7	30.4%
No	17	94.4%	55	94.8%	16	69.6%
Total	18	100%	58	100%	23	100%

Table 6: Proportion of smoker were higher in mild cognitive impairment group, however this difference was not statistically significant (P >0.05). PO_2 as 76.39 mmHg in mild cognitive impairment group while it was 87.25 mmHg in no cognitive impairment group. This difference was statistically significant (P<0.01). PCO_2 was 47.36 mmHg in mild cognitive impairment group while it was 40.34 mmHg in no cognitive impairment group. This difference was statistically significant (P<0.01).

Variables		*Cognitive impairment*				*P value*
		Mild (n=11)	*%*	*No (n=88)*	*%*	
Smoking	Yes	9	81.8%	60	68.2%	0.353
	No	2	18.2%	28	31.8%	
PO_2		76.39	5.935	87.25	4.752	< 0.01
PCO_2		47.36	6.592	40.34	3.308	< 0.01

4. Discussion

The present study was conducted to assess cognitive function in patients of Chronic Obstructive Pulmonary Disease. Chronic obstructive pulmonary disease (COPD) is a pathological condition of the respiratory system commonly diagnosed in the fifth decade of life and characterized by a high socioeconomic impact[26]. COPD is only partially reversible and can progressively affect the function of other organs (eg, heart, vasculature, muscles, kidney, liver, gastroenteric apparatus, and brain) causing different comorbidities of various severities including cognitive impairment. COPD effects on cognition are still poorly understood; indeed, this comorbidity has not been investigated as extensively as other pathologies [27] ; Cognitive function impairment was found to be associated with severe pulmonary dysfunction long ago, although its prevalence varied from study to study[28] and was dependent on the specific diagnostic criteria adopted, the methods used for assessing the impairment, and the number of subjects investigated[29].

Several studies investigating cognition in subjects with chronic airflow limitation had methodological limitations, including lack of clinical assessment of airflow impairment; a specific focus on cognitive impairment in elderly subjects with severe respiratory conditions; a lack of interest in subjects without a defined respiratory disease; a lack of extensive comparison of cognitive impairment in COPD subjects versus subjects with other chronic airway disorders and/or healthy subjects; a lack of multiple psychometric tools; and small sample sizes.

Demographic Profile

The present study comprises of 99 patients in Case group suffering from COPD and 99 patients in control arm not suffering from COPD. In case and control group 30.3% were female while remaining 69.7% were male.

In the study conducted by William W. Hung,[30,31] the proportion of female cases in the no COPD, COPD and Severe COPD group were 56.7%, 57.4% and 62.9%. The

association between gender and COPD cases was found to be statistically insignificant.

In the study conducted by Neeta Thakur et al,[32] the proportion of female gender in COPD group was 57.4% and in the control group was 61%. In the study conducted by Roberto W Dal Negro,[33] 68.1% were males and 31.9% were females. The results of this study were comparable to the present study. In the study conducted by Jing Li and Guang-He Fei,[34] the proportion of female was 38%. Mean age of subjects in case group was 56.88 years while it was 56.92 years in control group. There was no statistical difference in mean age of both the group (p >0.05). In the study conducted by Neeta Thakur et al, the mean age of the cases in the COPD group is 58.2 (SD 6.2) years and in the control group is 58.5 (SD 6.2) years. In the study conducted by Gupta et al,[35] the mean age of the cases in the COPD group was 57.25 (SD 9.07) years and in the control group is 56.9 (SD 9.21) years (p >0.05). In the study conducted by Jing Li and Guang-He Fei,[34] the mean age was 66.48, 69.27 and 67.60 years in control group, mild to moderate COPD group and severe COPD group respectively. BMI was lower in case group and this difference was statistically significant (p <0.05). In the study conducted by Roberto W Dal Negro,[33] the mean BMI in COPD group was 27.1 (SD 5.6) while in the asymptomatic smokers it was 26.9 (SD 4.5). The BMI in the present study was much lower than the study conducted by Roberto W Dal Negro. It was observed from the Roberto W Dal Negro study that substantial cognitive dysfunction was slightly related to BMI.

Smokers have a more chances of developing COPD in the long run. In the study conducted by Gupta et al, [35] none of the control was smoker while in case group average cigarette smoking per day was 39.95 (SD 20.94). In the study conducted by Manju Bhaskar,[36] 80% cases had smoking abuse in case group and 30% cases in the control group had smoking abuse. The association between the smoking and COPD occurrence was statistically significant in Manju Bhaskar Study. The most important cause of COPD is smoking. Not only active smoking, but also passive exposure to smoking, air pollution and occupational chemicals contribute to a higher risk for COPD in both high- and lowincome countries. Because of the slow progression of the disease, COPD is frequently not diagnosed until after the age of 40. It's for this reason that the overall prevalence is low before the age of 40 and increases with age. As a result of an increase of smoking amongst women and a greater risk of exposure to air pollution, prevalence amongst men and women is almost equal today (World Health Organization [WHO], 2009).

Arterial blood gas analysis was carries out in all subjects of case and control groups. In cases mean PaO was 86.04 with standard deviation of 5.95 while mean PaCO2 was 41.12 with standard deviation of 4.37. In [37] control group mean PaO was 93.07 with standard deviation of 3.25 while mean PaCO2 was 38.00 with standard deviation of 2.29. In Pulmonary Function Test, conducted in cases only, mean FEV1 was 1.42 with standard deviation of 0.49. In the study conducted by Roberto W Dal Negro,[33] the mean PaO2 in the COPD group is 69.5 (SD 11.3) while in the asymptomatic smokers group it was 81.5 (6.1) while mean PaCO2 in the COPD group is 43.5 (SD 10.6) while in the asymptomatic smokers group it was 38.3 (7.7). In the present study, PaO was 76.39 mmHg in mild cognitive impairment group while it was 87.25 mmHg in no cognitive impairment group. This difference was statistically significant (P<0.01) while PaCO2 [38] was 47.36 mmHg in mild cognitive impairment group while it was 40.34 mmHg in no cognitive impairment group. This difference was statistically significant (P<0.01). In the study conducted by Jing Li and Guang-He Fei, [34] the mean PaO2 was 91.82, 71.89 and 66.36 in control group, mild to moderate COPD group and severe COPD group respectively. The difference was found to be significant. In the same study conducted by Jing Li and Guang-He Fei, [34] the mean PaCO2 was 37.00, 40.27 and 48.27 in control group, mild to moderate COPD group and severe COPD group respectively. The difference was found to be significant. In the present study mean FEV1 was 1.42 with standard deviation of 0.49 in case group. In the study conducted by Gupta et al, [35] the mean FEV1 of the cases in the COPD group was 1.48 (SD 0.50) which is comparable with our finding. In the study conducted by Jing Li and Guang-He Fei, the mean FEV1 (% of predicted FEV) was 106.1, 61.14 and 34.15 liters in control group, mild to moderate COPD group and severe COPD group respectively. The difference was found to be significant.

COPD and MMSE –

All cases and controls were assessed for MMSE score. Comparison of MMSE score in cases and control group revealed that mean score in Attention, recall and Language is significantly lower in case group compare to control group. Total MMSE score was also significantly lower in case group. In orientation and registration there was no significant difference in case and control. In the study conducted by Manju Bhaskar, [36] the mean score in orientation was 9.40 (SD 0.855) in COPD group and 9.567 (SD 0.728) in control group, in registration was 3.0 (SD 0.0) in COPD group and 3.0 (SD 0.0) in control group, in attention was 4.36 (SD 0.89) in COPD group and 4.90 (SD 0.305) in control group, in recall was 2.167 (SD 0.874) in COPD group and 2.60 (SD 0.49) in control group, in language was 7.933 (SD 0.254) in COPD group and 8.00 (SD 0.0) in control group, in construction was 0.933 (SD 0.254) in COPD group and 1.0 (SD 0.0) in control group. The total score in the COPD group was 27.833 (SD 2.245) and 29.167 (SD 1.147) in control group. In the study conducted by *James W. Dodd,* the mean MMSE score in COPD stable group was 28 (SD 2), in COPD exacerbation group was 27 (SD 4) and control group was 30 (SD 1). The association between the MMSE score and COPD group was statistically significant. In the study conducted by Gupta et al, [35,39] the mean MMSE score of the cases in the COPD group was 22.48 (SD 2.42) and in the control group is 27.85 (SD 1.51) and similar to the present study the difference was significant (p <0.001) indicating that MMSE score is lower in COPD cases. In the study conducted by Jing Li and Guang-He Fei, [34] the mean MMSE score was 28, 24.57 and 22.15 years in control group, mild to moderate COPD group and severe COPD group respectively. The difference was found to be significant (p<0.001).[40] There are total 12 cases of mild cognitive impairment among the total 198 subjects. The mild cognitive impairment rate was 11.1% in case group

while it was 1.0% in control group. So, the cognitive impairment is higher in case group and this difference was statistically significant ($p<0.01$). In the present study, MMSE score and PaO ere significantly positively correlated. MMSE score increases with increase in the PaO2 value. MMSE score and PaCO2[41] were significantly negatively correlated. MMSE score increases with decrease in the PaCO2 value. In the early stages of COPD, The most often reported findings of cognitive impairment in patients with COPD are impaired attention functions (Klein et al., 2009;). [42] An increase in information processing speed, less accuracy in responses to verbal and visual stimuli, impaired orientation, executive and constructive functions have also often been reported in COPD patients (Özge et al., 2006). [43] One study, however, reported that visual attention abilities were well-preserved compared to he group of normal elderly adults, but they noted that this was most likely due to distractibility of the group of older subjects (Antonelli Incalzi et al., 1993).[44]

Memory is also reported to be impaired in patients with COPD, most often in the more severe stages of COPD. For example, significant impairments were found on immediate free recall, verbal memory, recent memory and long-term storage strategies in patients with COPD (Özge et al., 2006).[43] Liesker et al. (2003) [45] however, did not find a significant difference for memory, possibly because of the use of medicine by patients with COPD or perhaps because the COPD wasn't severe enough in the patients.

GOLD Stage of COPD and Cognitive Impairment -

In the present study, all cases were also divided according to the GOLD staging of COPD. In mild COPD there were 18 subjects while in moderate category there were 58 subjects while there were 23 subjects having severe COPD GOLD staging. In the study conducted by Jing Li and Guang-He Fei,[34]

37 subjects were having mild to moderate COPD Gold staging while 48 subjets were classified as Severe COPD GOLD staging. Except for the Registration, MMSE score was significantly lower as the severity of COPD increases. The same was also reflected in total score. Total MMSE score decreased as the severity of COPD increases.

Proportions of subjects having exposure to chulha smoke were 16.7% in mild COPD, 34.5% in moderate COPD and 21.7% in severe COPD. Thus proportion of chulha smoke exposure was higher in moderate category followed by severe category. Proportion of smoker was 72.2% in mild COPD, 65.5% in moderate COPD and 78.3% in severe COPD. Thus proportion of male was higher in all three categories and it was nearly similar in all three categories. Mild cognitive impairment rate was 5.6% in mild COPD, 5.2% in moderate COPD and 30.4% in severe COPD. Thus cognitive impairment was very high in severe COPD GOLD stage compare to mild and moderate COPD. Cognitive impairments can be found through all stages of the disease. However, the relation of the severity of symptoms with the stage of severity of COPD is still unclear. Some patients may have no symptoms or complaints until later stages, and some may have many symptoms early on. Especially in the early stages of COPD cognitive impairment is often limited to attention problems and information processing speed. As COPD progresses to a more advanced stage the impairments become more severe and diffuse. Orientation, executive functions and memory seem to be most affected , however, these are also most often researched. The results indicate that there are many possible factors that contribute to cognitive impairment in patients with COPD. One possible contributing factor could be a lack of oxygen, often found in the more severe stages of COPD. A comparison between hypoxemic or oxygen dependent COPD patients and non-hypoxemic/ oxygen dependent patients, showed an effect of lack of oxygen on cognitive functioning. Cognitive impairments were both more severe and diffuse in patients with hypoxemia. This suggests that perhaps in the later stages of COPD hypoxemia and/or hypercapnia, as a result of lack of oxygen, start playing [46] a more important role in the underlying mechanism of impaired cognitive functioning in COPD. Perhaps the role of lack of oxygen in patients with COPD is an indirect one, by causing other complications such as sleep disturbances (Özge et al., 2006).[43] Among the subjects having mild cognitive impairment, 81.8% were smoker while in subjects without any cognitive impairment 68.2% were smoker. Thus proportion of smoker were higher in mild cognitive impairment group, however this difference was not statistically significant ($P>0.05$).

5. Conclusion

The present study concludes that patient with chronic obstructive pulmonary disease have significant cognitive impairment compared to healthy controls. The present study concludes that hypoxaemia, hypercapnia, lung function, smoking and BMI are important risk factors for cognitive impairment in COPD patients. Cognitive impairment was very high in severe COPD GOLD stage compare to mild and moderate COPD.

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