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Study of Pulmonary Function Tests in Non-smoker Male Patients with Alcoholic Liver Cirrhosis

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Abstract

Introduction

Pulmonary function tests are extremely helpful in determining lung function. Pulmonary complications in cirrhosis of the liver with portal hypertension can arise owing to a variety of causes, including ascites restricting lung expansion and high portal pressures creating intrapulmonary vascular shunts.

Aim

To study the pulmonary functions using spirometry and diffusing capacity of the lungs for cirrhosis.

Methods

A cross-sectional observational study was done between August 2018 to September 2020. A total of 50 male non-smokers who were diagnosed cases of cirrhosis of the liver above the age of 18 years were subjected to the following investigations – Chest x-ray,

Ultrasonography of abdomen and pelvis, Spirometry, Diffusion Lung Capacity for Carbon monoxide (DLCO). The cases were divided into three groups based on their Child Pugh staging and statistical analysis was done on the collected data.

Results

Total 50 males who were diagnosed with alcoholic liver cirrhosis with a mean age of 52.3 ± 6.5 years. Total 24, 16 and 10 patients were in Child Stage A, B and C respectively. Breathlessness (44%) and cough (22%) were the common respiratory symptoms found in the subjects. Bilateral pleural effusion (20%) was the commonest respiratory finding on chest X-ray and on abdominal ultrasound examination the commonest findings were as cites (67.2%) and splenomegaly (45%). There was a statistically significant difference in the ratio FEV1/FVC and DLCO from stage A to stage C (ANOVA test p-value < 0.05).

Conclusion

Pulmonary Function Tests showed a statistically significant difference in the FEV1/FVC ratio and DLCO with worsening of CTP score (stage A to stage C). Other PFT parameters like FEV1, FVC and FEV 25-75% did not differ significantly across CTP stages.

Keywords

Alcoholic liver cirrhosis, Cirrhosis of the liver, Respiratory Function Tests.

Introduction

The liver plays a central role in the metabolism and maintenance of homeostasis. Thus, chronic liver disease like cirrhosis has deleterious effects on multiple organ systems including the respiratory system.

Pulmonary function tests (PFTs) are done to assess lung function. PFT is done to know about the involvement of the large and small airways, the integrity of the pulmonary vasculature and the extent of the involvement of pulmonary parenchyma in a patient with respiratory disease although it does not provide a diagnosis per se.[1]

In patients with cirrhosis of the liver, there may be abnormalities in the pulmonary functions due to multifactorial aetiologies. Changes of airway obstruction as well as a restriction (increase in the alveolar-arterial oxygen difference) and reduction in residual volume (RV), total lung capacity (TLC) and diffusing capacity of the lungs for carbon monoxide(DLCO) have been noted during pulmonary function testing in patients with alcoholic liver cirrhosis.

The current study aims to study the PFTs in non-smoker male patients with alcoholic liver cirrhosis and to study the correlation between child Pugh score and PFTs.

Material and methods

This was a cross-sectional study done at a tertiary care hospital in western Maharashtra, India, between January 2019 to January 2020 on 50 male patients more than 18 years of age who were diagnosed with alcoholic liver cirrhosis with portal hypertension (ultra-sonogram of abdomen, pelvis and upper gastrointestinal endoscopy proved). Patients with ischemic heart disease and primary interstitial and parenchymal lung diseases were excluded. Patients with smoking history whether current smokers or ex-smokers were excluded from the study.

Ethics committee approval was taken prior to the commencement of the study. Informed consent was taken from all the patients enrolled in the study.

Spirometry was done before and after the bronchodilator drug through nebulisation using a Spiro-analyser. The best of three consecutive spirometry recordings were used. Measurements included assessments of

A. FEV1 (Forced Expiratory Volume in 1 second in Liters)

B. FEV1/FVC ratio (%)

C. FVC (Forced Vital Capacity in Liters)

D. FEV 25-75% (Forced Expiratory flow, 25-75%)

E. PEF (Peak Expiratory Flow in Liters /second)

The patients were divided into three classes (class A, B, C) based on their Child-Pugh scores. The child score was calculated as shown in table 1.The score ranged from 5 to 15 and was calculated by adding the individual scores of the above mentioned five parameters.

When the score is between -

- 5 to 6 – CTP class A
- 7 to 9 – CTP class B
- 10 to 15 – CTP class C

Table 1. Child - Pugh Classification of Cirrhosis

Factor	Units	Points Towards Total Score		
		1	2	3
Serum bilirubin	mg/dL	<2.0	2.0-3.0	>3.0
Serum albumin	g/dL	>3.5	3.0-3.5	<3.0
Prothrombin time	Seconds prolonged INR	<4 <1.7	4-6 1.7-2.3	>6 >2.3
Ascites		None	Easily controlled	Poorly controlled
Hepatic encephalopathy		None	Minimal	Advanced

Chest x-ray, Ultrasonography of abdomen and pelvis were done apart from the other routine biochemical investigations. Data collection and analysis was done and entered into Microsoft excel and Epi-info software. The frequency distribution and graphs were prepared for all the variables. Following statistical tests were applied - Pearson Chi-square test for the categorical variables and the Student T-test for the quantitative variables; ANOVA test was used for the comparison between 3 categories of Child-Pugh grading. The tests were considered statistically significant if the p-value was less than 0.05.

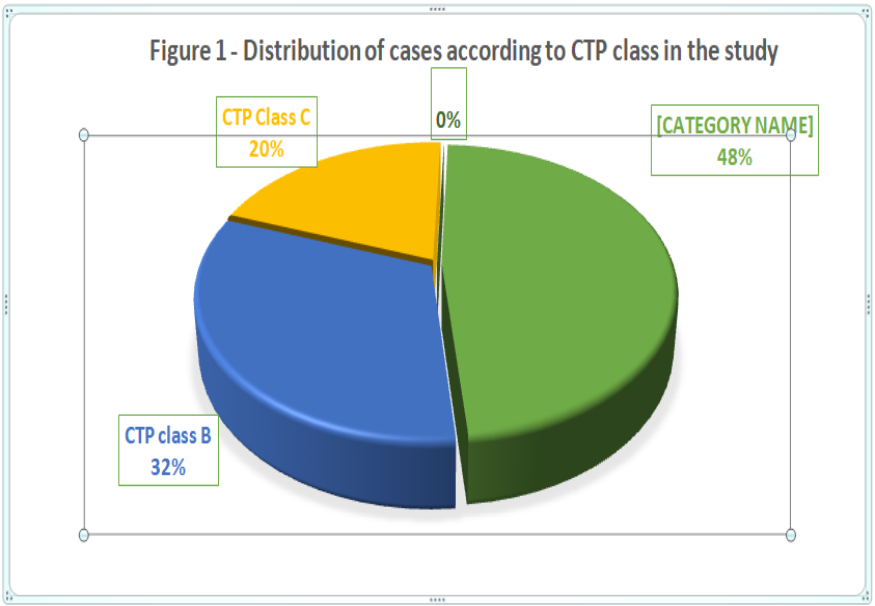
Results

Total 50 males diagnosed with alcoholic liver cirrhosis were included in the study. The average age of the patients was 52.3 ± 6.5 years. Table 2 shows the clinical features on admission in the study subjects.

Table 2. Clinical Features at Presentation (n = 50)

Symptoms	Number of patients having the symptoms	Percentage (%)
Jaundice	40	80
Abdominal Distention	35	70
Pedal Edema	34	68
Hepatic encephalopathy	8	16
Hematemesis	18	36
Malena	15	30
Fever	17	34
Cough	11	22
Breathlessness	22	44

The maximum number of participants were in Child-Pugh class A (n=24) (48%) in the study group. 16% of patients were Child-Pugh class C and the remaining were in Child-Pugh class B (36%).



It was observed that the average pulse rate was on the higher side (90.69 ± 23.24 per min) while average systolic BP was on the lower side (97.78 ± 9.22) in the study subjects.

Total 60% of patients had normal respiratory system examination. Patients in Child-Pugh class Chad shown statistically significant respiratory system examination findings as compared to Child-Pugh stages A and B ($P < 0.05$).

Table 3 shows the correlation of various biochemical parameters with CTP class in the patients. The total bilirubin, AST, ALT, serum albumin were the laboratory parameters that were significantly different across the CTP class A to C.

Table 3. Correlation of Various Biochemical Parameters with CTP Stage in the Study Subjects

Biochemical parameters	n=50 Mean ± SD	CTP stage A (n=24) Mean ± SD	CTP stage B (n=16) Mean ± SD	CTP stage C (n=10) Mean ± SD	P-value (By ANOVA Test)
Platelets (per µL)	2.03 L ± 63361	2.37 L ± 35124	2.25L ± 25612	2.14L ± 32769	0.10
Total Bilirubin (mg/dL)	3.85 ± 1.82	2.90 ± 1.18	3.74 ± 1.18	6.54 ± 1.67	**0.001**
Direct Bilirubin (mg/dL)	2.62 ± 1.47	2.41 ± 1.03	2.76 ± 1.01	2.51 ± 1.07	0.46
Indirect Bilirubin (mg/dL)	1.10 ± 0.72	0.92 ± 0.30	1.25 ± 0.70	1.13 ± 0.51	0.10
AST (U/L)	100.62 ± 62.92	71.21 ± 39.38	102.86 ± 63.69	180 ± 28.93	**0.001**
ALT (U/L)	120.54 ± 64.96	80.04 ± 38.33	111.71 ± 68.41	190.33 ± 26.9	**0.001**
ALP (U/L)	103.73 ± 27.03	97.04 ± 10.59	108.11 ± 26.4	104.92 ± 23.67	0.17
Total Protein (g/dL)	7.17 ± 0.74	7.21 ± 0.69	7.14 ± 0.64	6.72 ± 0.54	0.09
Albumin (g/dL)	3.25 ± 0.46	4.21 ± 0.53	3.22 ± 0.29	2.99 ± 0.38	**0.001**
Globulin (g/dL)	3.13 ± 0.33	3.11 ± 0.35	3.06 ± 0.29	3.33 ± 0.33	0.06
AG Ratio	1.25 ± 0.25	1.37 ± 0.22	1.21 ± 0.36	1.24 ± 0.16	0.12
Sr Creatinine (mg/dL)	1.2 ± 0.58	0.99 ± 0.20	1.17 ± 0.56	1.13 ± 0.64	0.3
Sr Urea (mg/dL)	16.02 ± 11.75	13.35 ± 3.51	17.25 ± 10.82	17.46 ± 11.82	0.24
Sr Sodium (mmol/L)	142.13 ± 5.29	139.75 ± 1.48	142.14 ± 5.48	141.83 ± 6.77	0.17
Sr Potassium (mmol/L)	3.99 ± 0.47	3.98 ± 0.20	3.99 ± 0.44	4 ± 0.85	0.99

Table 4. Chest X-Ray Findings In The Study Subjects

Chest X ray findings	**Total** (n=50) (Percentage %)
Normal	36 (72%)
Consolidation	2 (4%)
Unilateral Pleural effusion	2 (4%)
Bilateral Pleural effusion	10 (20%)

Table 4 shows chest x-ray findings in the study subjects. Bilateral pleural effusion was the commonest finding. Ascites (67.2%) and splenomegaly (45%) were the common findings on abdominal ultrasound examination.

Table 5. Correlation Of Pulmonary Function Tests (PFT) with CTP Stages

PFT Parameters	Normal Values	Total (n=50)	CTP stage A (n=24)	CTP stage B (n=16)	CTP stage C (n=10)	P-value
FVC in litres (Mean ± SD)	1.76 - 2.79	2.05± 0.15	2.07± 0.08	2.02± 0.18	2.09± 0.09	0.11
FEV_1 in litres (Mean ± SD)	1.31 - 2.25	1.68 ± 0.19	1.66± 0.08	1.70± 0.15	1.63± 0.09	0.07
FEV25-75% (L/s) (Mean ± SD)	3.6 – 4.8	4.23± 0.37	4.26± 0.41	4.28± 0.31	4.29± 0.49	0.15
FEV_1/FVC (Mean ± SD)	74.9 - 91.3	75.95± 2.56	77.17 ± 2.56	76.90 ± 3.09	69.58 ± 1.90	**0.001**
DLCO ml/min/mmHg (Mean ± SD)	20.4 – 32.12	21.90 ± 4.95	25.00 ± 3.68	27.88 ± 4.29	17.38 ± 2.95	**0.001**

There was a statistically significant difference in the ratio FEV1/FVC and DLCO from stage A to stage C (ANOVA test p-value < 0.05).

Discussion

In the present study, there were a total 50 patients. In other similar studies where PFTs were studied in cirrhotic patients, the age group at presentation was between 41 - 50 years. [2,3,4.] Age distribution and mean age of presentation was similar to the current study in a study done by Alkhyat et al., where 90 cirrhotic patients were included to study the pulmonary dysfunction in cirrhosis of the liver.[5]

Most of the patients in the current study presented with jaundice (80%) and abdominal distension (70%). In an Egyptian study, jaundice was present in 11.1%, abdominal distention in 47.78%, and dyspnoea in 55.56% of cases.[6] Thus, Indian patients with liver cirrhosis commonly presented with jaundice and as cites. Upper GI bleeding was not a common presentation in the current study.

Dyspnoea was found in 44% and cough was found in 22% of cases in the current study. In research done to study the relationship of PFTs with the severity of liver cirrhosis, dyspnoea was found in 44% of cases. In another Egyptian study, dyspnoea was found in 55.56% of patients which was similar to the current study.[4,5]

In our study, out of 50 subjects, 24 (48%) were in CTP stage A, 16 (32%) were in stage B, 10 (20%) in stage C.

Table 6 - Patient distribution as per the CTP stages in variousstudies.[2,3,4,7,8,9]

Name of the study (Year of publication)	Total number of study subjects	Number of patients in CTP stage A (%)	Number of patients in CTP stage B (%)	Number of patients in CTP stage C (%)
Awad et al. (2019)	50	17 (34%)	17 (34%)	16 (32%)
Khiangte et al. (2019)	64	4 (6.3%)	19 (29.7%)	41 (64%)
Henriksen et al.(2014)	66	10 (15.2%)	32 (50%)	24 (36.4%)
Park et al. (2012)	44	16 (36.4%)	13 (29.5%)	15 (34.1%)
Moller et al. (2009)	50	18 (%)	21 (%)	11 (%)
Yigit et al. (2007)	39	7 (17.9%)	21 (53.8%)	11 (28.2%)

In our study, 26 patients (40.6%) had abnormal respiratory findings on examination. In a study by Yigit et al., 46.2% of patients had respiratory symptoms and 33.3% of patients had proven hypoxemia on investigations.[3]On doing chest x-ray we found that 26.5% of cases had pleural effusion and the CT thorax showed pleural effusion in 42.3% of cases. In a similar study done in Greece, it was found that about 14.28% of cases had pleural effusion.[10]

AST, ALT, total bilirubin and albumin showed statistically significant difference across the CTP stages in our study. The study by Helmy et al. did not find any significant difference across the CTP stages for haemoglobin, AST as well as ALT.[11] In the study done by Awad et al., a statistically significant difference was found with ALT, total bilirubin and albumin across the CTP stages which was similar to our study.[4]

Ascites and splenomegaly were observed in 67.2% and 43.75% of the patients by ultrasonography in our study. This was similar to the findings in a study by Helmy et al. (ascites in 70.7%).[11]

In the present study, FEV1/FVC and DLCO were significantly different across the CTP stages. There was a fall in both the parameters with worsening of the CTP stage. There was an insignificant difference between FEV1, FVC and FEV25-75 across CTP stages. This was in contrast to the study done by Alkhayat et al. where the Child-Pugh class C had worse FEV1 and FVC values than the other CTP classes, which was shown to be statistically significant.[5]

Yigit et al. found that the FEV1/FVC to be lower in CTP stage B and didn't find any statistically significant difference among the three CTP stages.[3] In a study with Moller et al., they didn't find any correlation between DLCO and CTP staging but significantly lower in cirrhotic patients than with the control group.[9] Contrary to this study and corroborating to our study Park et al. found a statistically significant reduction in DLCO across CTP staging.[2]

Small sample size and selection bias were the limitations of our study.

Conclusion

Pulmonary complications in chronic liver diseases were common with dyspnoea being the

presenting symptom. Pulmonary Function Tests showed a statistically significant difference in the FEV1/FVC ratio and DLCO with worsening of CTP score (stage A to stage C). Other PFT parameters like FEV1, FVC and FEV 25-75% did not differ significantly across CTP stages.

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