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***Original Research Article***

# Mean Change in Respiratory Functions With Paracentesis in Chronic Hepatitis C Patients With Cirrhotic Ascites

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**Abstract:** *Chronic Hepatitis C (CHC) with cirrhotic ascites is associated with significant respiratory dysfunction due to mechanical compression of the diaphragm and lungs.* ***Objective:*** *To evaluate the mean change in respiratory functions following paracentesis in patients with chronic Hepatitis C and cirrhotic ascites.* ***Methods:*** *A cross-sectional study was conducted at the Department of Internal Medicine, Akhtar Saeed Trust Hospital, Lahore. A total of 154 patients aged 25-65 years with chronic Hepatitis C and cirrhotic ascites were enrolled. Patients underwent baseline assessments of respiratory function, including circumferential measurements and ventilometry, 30 minutes before and after paracentesis.* ***Results:*** *Significant improvements in respiratory function were observed following paracentesis. Tidal volume increased by 90 ± 50 mL ($p < 0.001$), minute volume by 0.8 ± 0.4 L/min ($p < 0.001$), and vital capacity by 0.6 ± 0.3 L ($p < 0.001$). Respiratory rate decreased by 2 ± 1 breaths/min ($p < 0.001$). Circumferential measurements at axillary, xiphoid, and umbilical reference points showed significant reductions, indicating decreased abdominal pressure. These improvements were consistent across gender and age groups.* ***Conclusion:*** *Paracentesis significantly improves respiratory function in patients with chronic Hepatitis C and cirrhotic ascites. The procedure reduces intra-abdominal pressure, enhances lung expansion, and improves ventilatory parameters. Paracentesis should be considered a valuable therapeutic intervention for both ascites and respiratory dysfunction in this patient population.*

**Keywords:** Paracentesis, chronic Hepatitis C, cirrhotic ascites, respiratory function, tidal volume, minute volume, vital capacity

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## Introduction

Chronic Hepatitis C (HCV) infection, a major public health concern worldwide, can lead to progressive liver damage, often culminating in cirrhosis. Cirrhosis exists as a pathologic condition because fibrosis and destruction of normal liver structure cause functional problems (1). Patient life quality decreases because ascites results in an enlarged belly and discomfort, together with respiratory problems and mobility constraints. Paracentesis represents a standard medical practice for treating symptomatic or tense ascites due to cirrhosis through needle or catheter ascitic fluid extraction from the peritoneal cavity (2). Patients gain immediate symptom relief of abdominal discomfort and dyspnea through paracentesis, while testing the ascitic fluid assesses causes of ascites like infection, malignancy, and other potential reasons (3). The liver parenchyma's continuous damage, destruction, and inflammatory process during chronic liver disease leads to fibrosis and cirrhosis. The disease CLD actively maintains its position as a main worldwide contributor to deaths and medical conditions. Ascites results in 116 million yearly mortalities unless we consider 3.5 percent of global death statistics (4). Chronic liver disease progresses through several stages until cirrhosis emerges as a condition that wrecks the typical liver structure. The peritoneal cavity accumulates pathological quantities of fluid, which is called ascites. Ascites becomes the primary complication of cirrhosis, affecting half of the patients who experience decompensated cirrhosis (5). Ascites formation indicates that patients have transitioned from compensated to decompensated cirrhotic disease. People with cirrhosis who have ascites face high chances of experiencing both spontaneous bacterial peritonitis (SBP) and hepatorenal syndrome (HRS) (6). Multiple elements that contribute to ascites development include portal hypertension, sinusoidal hypertension, and arterial vasodilatation, coupled with neurohumoral activation, resulting in sodium and water retention. Evaluating and surveilling patients with respiratory disorders heavily depend on pulmonary function tests (PFTs) (7). They provide important information relating to the large and small airways. The pulmonary parenchyma and the size and integrity of the pulmonary capillary bed. Although they do not provide a perfect diagnosis, different patterns of abnormalities are seen in various respiratory diseases, which help to establish a diagnosis. Ascites can be treated by large-volume paracentesis (LVP), transjugular intrahepatic portosystemic shunt (TIPS), vasoconstrictive drugs, and an automated low-flow ascites pump system. However, liver transplantation is the most effective treatment modality (8). However, liver transplantation is costly, and the number of donors is limited. Wittmer et al. (2020) observed that ventilometric parameters were mean vital capacity (1.72±0.98 vs. 1.99±1.10; P=0.000, mean change=0.27±0.12), mean minute volume (8.46±4.03 vs 9.62±5.96; P=0.001, Mean change=1.16±1.93). Mean tidal volume (0.56±0.25 vs. 0.69±0.32, P=0.000, mean change=0.13±0.07) before and after paracentesis in chronic hepatitis C patients with cirrhotic ascites (9). Similarly, Citrometry parameters were mean axillary (1.58±0.74 vs 2.43±1.91 p=0.001: mean change=0.85±0.74), mean xiphoid (1.73±0.98 vs. 1.97±1.03 P=0.142. Mean change=0.24±0.05) & mean umbilical (1.42±0.53 vs. 2.68±1.84 P=0.000; mean change=1.26±1.31) before paracentesis and after paracentesis in chronic hepatitis C patients with cirrhotic ascites. Therefore, ascites, especially when high in volume, impairs the pulmonary function in chronic hepatitis C patients with cirrhotic ascites. To the best of the candidate's knowledge, no such published study is available internationally and in the local population of Pakistan (10). Therefore, the current study aims to determine the mean change in pre- and post-paracentesis regarding differences obtained in axillary and abdominal citrometry parameters in chronic hepatitis patients with cirrhotic ascites. The results of the present study will give an insight

into the magnitude of the problem and will provide local baseline statistical data for further research in this regard.

Thus, the study aimed to determine the mean change in densitometry (vital capacity, minute volume, tidal volume) and cytometry parameters (axillary, xiphoid, umbilical) after paracentesis in chronic hepatitis C patients with cirrhotic ascites.

**Methodology**

It is a cross-sectional study conducted at the Department of Internal Medicine, Akhtar Saeed Trust Hospital, Lahore, from 18th October 2024 to 17th January 2025. Data were collected through the Non-Probability, Consecutive Sampling technique. A sample size of 154 is calculated with 80% power of the test and a 95% confidence interval, while taking the mean change in tidal volume as 0.13 ± 0.07 in chronic hepatitis C patients with cirrhotic ascites. Patients of both genders aged between 25 and 65 years having chronic hepatitis C with cirrhotic ascites (as per operational definition) were included in this study. Patients who are on diuretics and have not undergone paracentesis.Patients who give written informed consent to participate in this study. Patients have non-cirrhotic ascites. Active gastrointestinal bleeding, congestive heart failure, hepatocellular carcinoma, arterial hypertension, or any acute infection.Treatment with drugs known to affect systemic or renal hemodynamics within one week before initiation of the study.Patients with diabetes mellitus (fasting blood sugar ≥110mg/dl). Pre-existing liver disease (serum bilirubin ≥1.0mg/dl) and chronic kidney disease (serum urea ≥40mg/dl and creatinine ≥1.2mg/dl).Hemodynamically unstable patients (systolic blood pressure <80 mmHg) and inability to understand and perform the procedures for evaluation and diagnosis of pulmonary diseases.Those having difficulty in collaborating with the spirometric examination.Alcoholic patients (≥100 ml of alcohol/day). After approval from the ethical review committee of the hospital, 154 patients with cirrhosis and ascites with stable renal function (creatinine level <1.5 for at least 7 days) attending the medical outpatient department of the Internal Medicine Akhtar Saeed Trust Hospital, Lahore, who met the inclusion criteria, were enrolled in this study. Written informed consent and detailed history were taken from every patient. Age and gender of all patients (evaluated by the medical team). Vital signs (blood pressure, heart rate, respiratory rate, and peripheral oxygen saturation) were measured. Subsequently, a cirrhotic procedure assessed thoracoabdominal mobility, including axillary, xiphoid, and umbilical scars. Positioning the tape measure around the thorax and abdomen was used to verify the difference between the maximum inspiration and expiration measurements in the three reference points. The evaluation of ventilometry was performed using the "Ventilômetro Análogo de Wright Mark 8" device attached to a mouthpiece. In basal respiration, minute volume and respiratory rate were simultaneously obtained. Moreover, tidal volume was determined by dividing minute volume by respiratory rate. Vital capacity was obtained by asking the patient to perform a maximal inspiration followed by a slow maximal exhalation. All measurements were performed with the patient in a sedentary position approximately 30 minutes before and 30 minutes after the patient underwent paracentesis. Patient's demographic details, duration of disease, and chronic hepatitis C patients with cirrhotic ascites were noted and recorded into the attached proforma by the candidate herself. All the tests were acquired from the same (hospital) lab to eliminate bias. Confounding variables have been controlled by exclusion. All the collected data were entered and analyzed through SPSS version 20. Numerical variables such as Age, duration of disease, ventilometry (vital capacity, minute volume, tidal volume), and citrometry (Aillary, Xiphoid, Umbilical) are presented by mean ± SD. Paired sample t-test is applied to calculate the mean change in ventilometry and citrometry parameters after paracentesis. Categorical variables, i.e., gender, are presented by frequency and percentage. Data is stratified for age, gender, and duration of disease to address effect modifiers. Post-stratification paired sample t-test is applied, taking a p-value of <0.05 as statistically significant.

**Results**

Data were collected from 154 patients, with a mean age of 48.5 ± 9.2 years, with 62% male and 38% female participants. The mean duration of disease was 7.3 ± 3.6 years. Pre-procedure measurements indicated a mean blood pressure of 110/70 ± 10/5 mmHg, a heart rate of 85 ± 12 bpm, a respiratory rate of 20 ± 3 breaths per minute, and peripheral oxygen saturation at 95% ± 2%.

The axillary measurement decreased by 2.3 ± 0.5 cm, the xiphoid measurement reduced by 2.2 ± 0.6 cm, and the umbilical measurement decreased by 2.7 ± 0.7 cm, all with p-values less than 0.001, indicating statistically significant changes.

Minute volume increased by 0.8 ± 0.4 L/min, respiratory rate decreased by 2 ± 1 breaths/min, tidal volume increased by 90 ± 50 mL, and vital capacity increased by 0.6 ± 0.3 L, all with p-values less than 0.001.

For males, the mean change in tidal volume was 95 ± 52 mL, and minute volume increased by 0.9 ± 0.5 L/min, with a p-value of <0.001. Females experienced a mean change in tidal volume of 85 ± 48 mL and a minute volume increase of 0.7 ± 0.3 L/min, with a p-value of <0.001. In terms of age, the 25-45 years group had a mean tidal volume increase of 100 ± 60 mL and a minute volume increase of 1.0 ± 0.6 L/min, while the 46-65 years group had a tidal volume change of 80 ± 45 mL and a minute volume change of 0.6 ± 0.4 L/min, with all changes being statistically significant (p-value <0.001).

**Table 1: Baseline Characteristics of Study Participants**

| Variable | Mean ± SD |
|---|---|
| Mean Age (years) | 48.5 ± 9.2 |
| Gender (Male) | 62% (95) |
| Gender (Female) | 38% (59) |
| Duration of Disease (years) | 7.3 ± 3.6 |
| Pre-procedure Blood Pressure (mmHg) | 110/70 ± 10/5 |
| Pre-procedure Heart Rate (bpm) | 85 ± 12 |
| Pre-procedure Respiratory Rate (breaths/min) | 20 ± 3 |
| Pre-procedure Peripheral Oxygen Saturation (%) | 95% ± 2% |

**Table 2: Circumferential Measurements Before and After Paracentesis**

| Circumferential Measurement | Pre-paracentesis (cm) | Post-paracentesis (cm) | Mean Change (cm) | p-value |
|---|---|---|---|---|
| Axillary | 96.5 ± 3.2 | 94.2 ± 3.1 | -2.3 ± 0.5 | <0.001 |
| Xiphoid | 97.0 ± 3.5 | 94.8 ± 3.3 | -2.2 ± 0.6 | <0.001 |
| Umbilical | 100.1 ± 4.1 | 97.4 ± 3.9 | -2.7 ± 0.7 | <0.001 |

**Table 3: Ventilometry Results Before and After Paracentesis**

| Ventilometry Parameter | Pre-paracentesis | Post-paracentesis | Mean Change | p-value |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Minute Volume (L/min) | 7.3 ± 1.4 | 8.1 ± 1.2 | +0.8 ± 0.4 | <0.001 |
| Respiratory Rate (breaths/min) | 20 ± 3 | 18 ± 2 | -2 ± 1 | <0.001 |
| Tidal Volume (mL) | 360 ± 80 | 450 ± 90 | +90 ± 50 | <0.001 |
| Vital Capacity (L) | 3.2 ± 0.6 | 3.8 ± 0.5 | +0.6 ± 0.3 | <0.001 |

**Table 4: Stratified Analysis of Mean Change in Respiratory Parameters by Gender and Age**

| Group | Mean Change in Tidal Volume (mL) | Mean Change in Minute Volume (L/min) | p-value |
|---|---|---|---|
| Male | 95 ± 52 | +0.9 ± 0.5 | <0.001 |
| Female | 85 ± 48 | +0.7 ± 0.3 | <0.001 |
| Age Group | | | |
| 25-45 years | 100 ± 60 | +1.0 ± 0.6 | <0.001 |
| 46-65 years | 80 ± 45 | +0.6 ± 0.4 | <0.001 |

## Discussion

This study aimed to assess the impact of paracentesis on respiratory function in patients with chronic Hepatitis C and cirrhotic ascites. The paracentesis procedure provided substantial therapeutic benefits to respiratory parameters, demonstrating that the procedure helps both treat ascites symptoms and improve pulmonary health outcomes. Research data indicates that paracentesis treatment improved tidal volume measurements, increased vital capacity, decreased respiratory rate measurements, and higher minute volume readings (11). The measured increases in tidal volume to 90 mL alongside minute volume to 0.8 L/min and vital capacity to 0.6 L support the scientific explanation that paracentesis-driven ascites removal lowers intra-abdominal pressure to enhance diaphragmatic motion and lung capacity expansion. The ventilation process is enhanced, and the patients experience improved oxygenation. A decrease in breathing rate to two breaths per minute demonstrates improved pulmonary performance after the treatment has been performed according to (12).

According to published research, mechanical compression caused by ascitic fluid in the diaphragm and lungs results in impaired breathing capacity. Removing ascitic fluid through paracentesis enables the diaphragm to achieve better freedom of movement, improving breathing efficiency and gas exchange mechanisms (13). The measurements surrounding the axillary, xiphoid, and umbilical regions decreased significantly after performing paracentesis. The recorded findings prove that paracentesis creates objective reductions in abdominal distension and decreases thoracic cavity pressure. The measurements at the umbilical and xiphoid levels reveal a significant mean decrease after paracentesis, which proves its efficiency in reducing respiratory system load (14). The study findings demonstrated improved respiratory function across all participants in each gender category. Research results indicated that tidal and minute volumes showed slightly larger changes in males than females during the procedure (15). Research must confirm the possible explanations for these differences between genders, which could result from body composition variations, lung capacity, and ascites severity. People between 25 and 45 years old showed superior tidal volume measurements and minute volume output increases compared to participants from the 46 to 65 age group (16). The generally superior respiratory health and better reserve capacity in young individuals may explain why age is important in calculating the extent of paracentesis-induced respiratory improvement. Research findings show that paracentesis provides extensive medical advantages in addition to treating ascitic symptoms, according to studies 17-19. Improving respiratory function through paracentesis becomes a potential tool for patients with cirrhosis and ascites to increase their quality of life (20). Clinical practice should adopt paracentesis as both an ascites treatment method and as a technique to manage respiratory dysfunction in patients who present with severe complications because of excessive fluid accumulation. The study presents several negative points that need recognition. The study's cross-sectional design hinders our ability to demonstrate cause-and-effect relationships because it only presents a static picture. A prolonged research approach across time would deliver extended information about how paracentesis affects lung function.

## Conclusion

It is concluded that paracentesis significantly improves respiratory function in patients with chronic Hepatitis C and cirrhotic ascites. The procedure marked improvements in tidal volume, minute volume, vital capacity, and a reduction in respiratory rate. Circumferential measurements significantly decreased, indicating reduced intra-abdominal pressure and improved diaphragmatic movement.

## Declarations

**Data Availability statement**
All data generated or analysed during the study are included in the manuscript.
**Ethics approval and consent to participate**
Approved by the department concerned. (IRBEC-TCH855-24)
**Consent for publication**
Approved
**Funding**
Not applicable

## Conflict of interest

The authors declared the absence of a conflict of interest.

## Author Contribution

**FM** (PGR),
*Manuscript drafting, Study Design,*
**MSA** (House Officer)
*Review of Literature, Data entry, Data analysis, and article drafting.*
*Conception of Study, Development of Research Methodology Design,*

*All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.*

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