

# A study on clinicoradiological profile of patients with hydropneumothorax in a tertiary care hospital in Eastern India



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## ABSTRACT

**Background:** Hydropneumothorax is an abnormal presence of air and fluid in the pleural space. It is a common presentation in the Indian scenario. However, there is a scarcity of studies from Eastern India. **Aims and Objectives:** The study aimed to evaluate the clinical and radiological presentation, etiological factors, treatment modalities, and outcome of patients of hydropneumothorax. **Materials and Methods:** Descriptive, observational, cross-sectional study conducted in a tertiary care hospital for 1 year. Adult patients of both genders presenting with a diagnosis of hydropneumothorax were studied. Detailed history and clinical examination were recorded. Chest X-ray, blood, pleural fluid, sputum investigations, and computed tomography (CT) thorax were done. An intercostal drainage (ICD) tube was inserted and the duration of ICD stay was noted. **Results:** Thirty-six patients were studied. The mean age of presentation is  $40.8 \pm 14.8$  (Mean  $\pm$  SD) years with male predominance. Breathlessness and cough were the most common symptoms (86.1%). Right-sided hydropneumothorax was more common (52.7%). All patients had exudative pleural fluid. Cavity (38.9%) was the most commonly associated radiological finding in CT thorax. Tuberculosis (TB) was the most common etiology (61.1%), followed by acute bacterial infection (36.1%), and malignancy (2.7%). All patients have undergone ICD insertion. About 61.11% of patients had an ICD stay of less or equal to 15 days. **Conclusion:** Pleural fluid analysis is essential in establishing the etiological diagnosis of hydropneumothorax. TB is the common etiology. ICD insertion along with appropriate chemotherapy are essential components of management.

**Key words:** Hydropneumothorax; Tuberculosis; Chest tube drainage

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## INTRODUCTION

Hydropneumothorax is the abnormal presence of air and liquid (pus, fluid, or blood) in the pleural space. Knowledge about this entity has been known to clinicians dating back as far as the times of ancient Greece where the method of Hippocratic succussion was used to perform the diagnosis.<sup>1</sup> Hydropneumothorax can be due to lung parenchymal infection (either tuberculosis [TB] or any gas-producing organism forming a cavitory lesion or lung abscess) or it can occur due to rupture of cavitory lung mass into the pleural space. It has also been

reported secondary to thoracocentesis, thoracic trauma, esophagopleural fistula, or broncho/alveolo-pleural fistula.<sup>2</sup> The most common presenting complaint is breathlessness followed by cough.<sup>3</sup> Other symptoms that may be associated are fever, weight loss, or a history of thoracic trauma. On clinical examination, the diagnosis is suspected on the demonstration of certain salient findings such as straight-line dullness, immediate shifting dullness on percussion, and demonstration of succussion splash, coin test on auscultation.<sup>4</sup> The diagnosis in most cases is confirmed on erect chest X-ray, where it appears as radio-dense lower pleural space, radiolucent upper pleural

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space, and air/fluid level at their interface. Management of hydropneumothorax needs intercostal chest drain insertion and drug therapy according to the cause. Etiology may vary, although the most common cause is TB in India.<sup>3</sup>

There has been a quantum jump in the understanding of pleural physiology, laboratory parameters, radiological diagnosis, and management protocols for pleural diseases. However, despite being encountered quite frequently in clinical practice, literature regarding hydropneumothorax has been few and far between. Hence, this study aimed to evaluate the clinical and radiological presentation as well as to find out the etiological factors treatment modalities, and outcomes of patients presented with hydropneumothorax in a tertiary care hospital in the Eastern part of India.

### Aims and objectives

This study was aimed to evaluate the clinical and radiological presentation as well as to find out the aetiological factors and treatment modalities and outcome of patients presented with hydropneumothorax in a tertiary care hospital in Eastern part of India.

## MATERIALS AND METHODS

A descriptive, observational, hospital-based study with a cross-sectional design was conducted at the Department of Respiratory Medicine of Midnapore Medical College and Hospital, Paschim Medinipur, West Bengal, India, from March 2022 to February 2023. After obtaining clearance from the Institutional Ethics Committee (Ref. No. IEC/2022/01, dated- February 10, 2022), patients of age more than 12 years, of all genders, presenting with hydropneumothorax either clinically and/or radiologically were included in the study. Informed consent was taken from each participant or from their legal guardians when participants were <18 years old. Known cases of iatrogenic hydropneumothorax, traumatic hydropneumothorax, and patients unwilling to give consent were excluded. All the patients were enquired regarding symptoms such as breathlessness, fever, cough, chest pain, and constitutional symptoms such as loss of appetite and loss of weight. Patients were also enquired regarding the presence of comorbidities such as diabetes mellitus, hypertension, ischemic heart disease, history of TB, and any known immunocompromised status. A detailed clinical examination was done to check for the presence of straight-line dullness, immediate shifting dullness, and demonstration of succussion splash. A chest X-ray was done. Patients underwent routine hematological, biochemical, and serological tests. Sputum was collected and sent for Gram stain, pyogenic culture sensitivity, acid-fast bacilli (AFB) smear, cartridge-based nucleic acid amplification test (CBNAAT)/XPERT *Mycobacterium tuberculosis* Rifampicin (MTB RIF) assay. Diagnostic pleural fluid aspiration was done and it was analyzed according to the

gross appearance. If straw-colored, it was sent for analysis such as cell type, cell count, and presence of malignant cells along with biochemical analysis such as proteins, glucose, lactate dehydrogenase, and adenosine deaminase [ADA] level, and microbiological assessment such as Gram stain, pyogenic culture sensitivity, Ziehl–Neelsen staining and molecular diagnostic test for TB. If the pleural fluid appeared purulent then only a microbiological assessment was done. Contrast-enhanced computerized tomography (CT) thorax scan was done in patients with serum creatinine in the normal range and for those with deranged serum creatinine level, high-resolution CT thorax was done. All patients were treated with intercostal drainage (ICD) tube insertion with water-sealed drainage. After initial empirical treatment as per the etiological diagnosis, appropriate drug therapy was initiated. Daily fluid collection in ICD bag and movement of the fluid column was noted and follow-up chest X-rays were done initially after the insertion of ICD and then at regular intervals. Duration of ICD *in situ* was noted. Data were collected in a pre-designed pro forma, tabulated in Microsoft Excel and the data were statistically analyzed with the help of computer software designed for such purpose.

## RESULTS

Thirty-six patients of hydropneumothorax were included in this study. Mean age of presentation was 40.8 years  $\pm$  14.8 years (mean  $\pm$  SD). Thirty-four out of 36 patients (94.4%) were males. The most common presenting symptoms were (Figure 1) shortness of breath on exertion reported by 31 patients (86.1%) and cough also reported by 31 patients (86.1%). This was followed by chest pain seen in 22 patients (61.1%), fever seen in 20 patients (55.5%), and lastly by loss of appetite reported by 11 patients (30.5%).

A history of pulmonary TB was present in 7 patients (19.4%) and a history of contact with a case of TB was present in 5 patients (13.8%). Smoking addiction was present in 12 patients (33.3%) and diabetes mellitus was present in 3 patients (8.3%).

All the patients were subjected to chest X-ray. Localization of the site of hydropneumothorax was primarily done by chest X-ray which showed that 19 out of 36 patients (52.7%) had a right-sided hydropneumothorax, 15 patients (41.6%) had a left-sided hydropneumothorax and 2 patients (5.5%) had bilateral hydropneumothoraces (Figure 2).

CT scan was done for all the patients to look for any associated findings with hydropneumothorax. Fourteen patients (38.9%) had associated features of the cavity, 12 patients (33.3%) had consolidation, 7 patients (19.4%)

**Table 1 : Frequency distribution of associated radiological findings as seen on CT thorax**

Features	Frequency	Percent
Cavity	14	38.9
Consolidation	12	33.3
Cavity with consolidation	7	19.4
B/L lung nodules with mass lesions	1	2.8
Cavity with military opacities	1	2.8
Tree in bud opacity	1	2.8
Total	36	100

CT: Computerized tomography

**Table 2: Frequency distribution of the etiology of hydropneumothorax**

Etiology	Frequency	Percent
Tuberculosis	22	61.1
Microbiologically confirmed in sputum	11	
Microbiologically confirmed in pleural aspirate	3	
Microbiologically confirmed in both sputum and pleural aspirate	5	
Clinically diagnosed by pleural aspirate	3	
Acute bacterial infection of pleura	13	36.1
Malignancy	1	2.8
Total	36	100

**Table 3: Frequency distribution of duration of ICD stay**

Duration of ICD stay	Frequency	Percent
≤15 days	22	61.11
>15 days	14	38.89
Total	36	100

ICD: Intercostal drainage

had both cavity and consolidation, 1 patient (2.8%) had bilateral lung nodules with a mass lesion, 1 patient (2.8%) had cavity along with military opacities and 1 patient (2.8%) had a tree in bud opacities as associated findings (Table 1).

Pleural fluid aspiration was done for all patients. Frank pus was aspirated in 11 patients (30.55%) and the pleural fluid of the remaining 25 patients was sent for biochemical and cytological analysis. Biochemical analysis showed pleural fluid protein 4.74 g/dL (SD±0.75 g/dL), and glucose 43.28 g/dL (SD±36.78 g/dL). Based on Light's criteria, all patients had exudative effusion. The mean pleural fluid ADA was 86.21 IU/L (SD±64.81 IU/L). Pleural effusion was lymphocytic predominant in 12 patients (48%), and the remaining 13 patients (52%) had polymorph predominant.

Further investigation of pleural fluid and pus aspirate showed that 8 patients (22.2%) showed microbiological confirmation of mycobacteria (either AFB smear

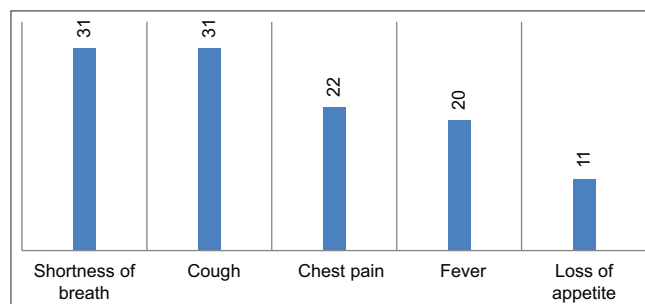


Figure 1: Bar diagram showing the frequency of presenting symptoms

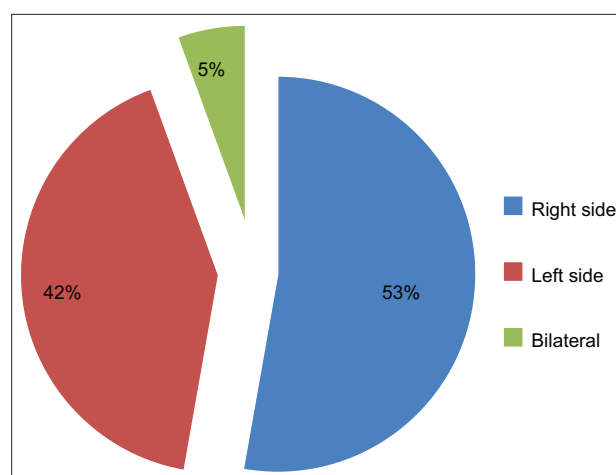


Figure 2: Pie chart showing localization of hydropneumothorax in the study population

positive and/or CBNAAT- MTB detected), 4 patients (11.1%) showed significant growth of bacteria other than mycobacteria in Gram stain and culture sensitivity report and 1 patient (2.7%) was found to have malignant cells.

Sputum analysis was also done for all the patients. Microbiological confirmation of mycobacterial infection (sputum positive for AFB stain and/or CBNAAT-MTB detected) was present in 16 (44.4%) out of 36 patients. Among those 16 cases, two cases were found to be RIF resistant by CBNAAT testing. Two patients (5.5%) out of 36, showed significant growth of bacteria other than mycobacteria in sputum Gram stain and culture sensitivity report.

TB was the most common etiological diagnosis found in 22 patients (61.1%), followed by acute bacterial infection other than mycobacteria in 13 patients (36.1%), and 1 patient (2.7%) was diagnosed as a case of malignancy (Table 2).

Among the 22 patients diagnosed with cases of TB, 11 patients (50.0%) were microbiologically confirmed by sputum examination (of which 2 cases were RIF resistant), 3 patients (13.63%) were microbiologically confirmed by

pleural aspirate, 5 patients (13.88%) had microbiological confirmation in both sputum and pleural fluid samples and 3 patients (8.33%) were clinically diagnosed as TB based on pleural fluid report.

All patients were treated with the insertion of ICD tube. Twenty-two cases (61.11%) had a duration of ICD less or equal to 15 days, whereas the remaining 14 cases (38.89%) had a duration of ICD more than 15 days (Table 3). Of the 14 cases that required ICD for more than 15 days, 5 cases (35.71%) had a bronchopleural fistula.

Chest tube-related complications were seen in 8 cases (22.22%). These included subcutaneous emphysema in 5 cases (62.50%), and dislodgement of tube in 3 cases (37.50%).

## DISCUSSION

Hydropneumothorax is a common presentation in the Indian scenario. Despite that, there have been isolated case reports and case series and a scarcity of large-scale studies, particularly from the eastern side of India.

The mechanism of development of hydropneumothorax is complex as it entails the mechanics of the development of both pleural effusion and pneumothorax. It can develop due to the rupture of the tuberculous cavity, due to the rupture of subpleural lung abscess, iatrogenic due to aspiration of fluid in pleural effusion, and due to superadded infection in the long-standing intercostal tube in pneumothorax. It may also develop due to penetrating chest injury. Other causes of hydropneumothorax include rupture of necrotic neoplastic tissue and necrotic tumor nodule within the pleural cavity, necrosis of the subpleural metastasis, and secondary infection due to obstruction by the tumor itself.<sup>5</sup>

The most common presenting complaints in our study were shortness of breath on exertion (86.1%) and cough (86.1%). This correlated with the study done by Kasargod and Awad,<sup>3</sup> where breathlessness was the most common presenting symptom seen in 94.7% of patients, followed by cough seen in 93% of patients. Gupta et al.,<sup>6</sup> and Javaid et al.,<sup>7</sup> in their studies on pneumothorax also reported breathlessness as the most common presenting symptom and present in 93% and 98% of patients, respectively. The reason for breathlessness being the most presented symptom is due to pleural involvement in hydropneumothorax, causing the collapse of the lung, leading to ventilation-perfusion mismatch.<sup>3</sup>

Other symptoms of chest pain, fever, and loss of appetite were seen in 61.1%, 55.5%, and 30.5% of patients, respectively, in this study. In a study on patients of tubercular pneumothorax by Blanco-Perez et al.,<sup>8</sup> reported

chest pain (90%), dyspnea (45%), cough (45%), and fever (36%) as the most frequently reported symptoms.

In our study, 52.7% had right-sided hydropneumothorax, 41.6% had left-sided hydropneumothorax, and 5.5% had bilateral hydropneumothoraces. This is in contrast to the findings of Singh et al.,<sup>9</sup> which showed left-sided hydropneumothoraces to occur more commonly than the right-sided.

CT scan was done for all the patients to look for any associated findings with hydropneumothorax. The most common finding was cavitation of the lung parenchyma seen in 38.9%. This was followed by consolidation in 33.3%, bilateral lung nodules with mass lesions in 2.8%, and tree in bud opacities in 2.8%. However, 19.4% of patients had features of both consolidation and cavitation in the lung parenchymal window of CT thorax. Yoon et al.,<sup>10</sup> in their radiological study of hydropneumothorax in *Mycobacterium avium* complex (MAC) lung disease reported that the peripheral portion of the involved lung demonstrated fibro-bullous changes or cavitory lesions causing lung destruction, reflecting the chronic, insidious nature of MAC lung disease.

On aspiration of pleural fluid, frank pus aspirated in 30.55% of patients, the rest had serous pleural fluid on aspiration. Light's criteria were developed with the goal to identify all exudates correctly and the criteria are remarkably effective in achieving this goal.<sup>11</sup> On applying Light's criteria, all patients in our study had exudative pleural effusion. The mean pleural fluid protein was 4.74 g/dL (SD±0.75 g/dL).

In our study, the pleural fluid differential count showed lymphocytic predominance in 48%, and 52% had polymorph predominance. The mean pleural fluid ADA was 86.21 IU/L (SD±64.81 IU/L). Of all the cases in which serous pleural fluid was aspirated, 76% had elevated ADA (i.e., ADA levels more than 40 IU/L), out of which 87.47% patients had TB as an etiology thus proving that determination of ADA levels has high accuracy in the diagnosis of the pleural TB and should be used as a routine test in its investigation.<sup>12,13</sup>

Further investigation of pleural fluid and pus aspirate showed that 22.2% of patients had microbiological confirmation of mycobacteria (either AFB smear positive and/or CBNAAT-MTB detected). A study by Kasargod and Awad,<sup>3</sup> who demonstrated AFB in pleural fluid in 14% of cases. A higher number of microbiological confirmation of cases may be because, our study included both AFB smear examination as well as CBNAAT of the pleural fluid aspirate, and CBNAAT being a more sensitive test.<sup>14,15</sup>

The most common etiology of hydropneumothorax in our study was TB (61.1%), followed by acute bacterial infection



other than mycobacteria (36.1%) and malignancy (2.7%). Our findings concur with the study by Kasargod and Awad,<sup>3</sup> which also found TB (81%) to be the most common cause of hydropneumothorax, followed by a bacterial infection (14%). The same study detected malignancy as the cause of hydropneumothorax in 3.5% of cases.

All patients were treated with the insertion of ICD tube. 61.11% of patients had a duration of ICD less or equal to 15 days. 38.89% of patients had a duration of ICD more than 15 days. Out of which, 35.71% of patients developed bronchopleural fistula. The study by Singh et al.,<sup>9</sup> reported that the mean duration of ICD was  $21.3 \pm 10.6$  days. The same study also reported that TB patients showed a longer duration of the requirement of ICD ( $27.1 \pm 9.0$  days) in comparison to the hydropneumothorax due to bacterial and malignant origin. Thoracoscopy or other interventions were not performed due to a lack of availability in our institute.

### Limitations of the study

A small sample size is the main limitation of this study. The data are not representative of the whole community as the study was conducted at one tertiary care center.

## CONCLUSION

The most common presenting symptom in the case of hydropneumothorax is shortness of breath associated with cough. Other symptoms such as chest pain, fever, anorexia, and weight loss may also be present. Extensive pleural fluid analysis and investigations including microbiological and biochemical workup are the cornerstone in establishing etiological diagnosis in hydropneumothorax. TB is the most common etiology behind hydropneumothorax. ICD tube insertion with underwater seal remains the mainstay of management along with antitubercular chemotherapy for TB cases and broad-spectrum antibiotics for cases associated with bacterial infection.

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**Authors Contribution:**


**FM**- Concept, literature search, investigation, data collection, data analysis, and reviewing the manuscript; **PM**- Guidance, investigation, validation, and reviewing the manuscript; **AM**- Literature search, data analysis, interpretation, manuscript writing, and editing; **AD**- Coordination, data collection, literature search, data analysis, reviewing, and editing the manuscript; **PM**- Data collection, data tabulation, literature search, and manuscript writing

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