

The prevalence of pneumothorax in human immunodeficiency virus patients. A single center study

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ABSTRACT

Objectives: To assess the prevalence, risk factors, and associated complications of pneumothorax that are present in patients with human immunodeficiency virus (HIV) at our institution and to provide an updated local study addressing the association between pneumothorax and HIV.

Methods: This retrospective cohort study examined 161 patients who were admitted with a diagnosis of HIV from June 2017 to May 2022. They were divided into 2 groups depending on the presence of pneumothorax during their stay. Multiple variables were studied, including age, gender, tuberculosis infection, pneumocystis jiroveci pneumonia (PJP) infection, bacterial pneumonia, and pneumothorax type and treatment course.

Results: There were 11 patients diagnosed with pneumothorax (prevalence rate: 6.8%). Bacterial lung infection was found in 9 (81.8%) of these patients, while fungal infection was found in 6 (54.5%) ($p < 0.001, 0.010$). The MTB was found in 3 (27.3%) patients ($p = 0.728$), while none were infected with PJP. Intercostal tube insertion was attempted in 9 (81.8%) patients, the mean duration of tube stay was 39.3 ± 30.7 days, and the mortality rate was 72.7% ($p = 0.007$).

Conclusion: Pneumothorax in patients with HIV is a manifestation of the progression of the disease and its poor outcome. It has a complicated treatment course and a high mortality rate.

Keywords: pneumothorax, human immunodeficiency virus, opportunistic lung infections

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It was reported that the incidence of spontaneous pneumothorax in patients with human immunodeficiency virus (HIV) is 450 times higher than that of the general population, and they have higher complication rates (30-60%) due to the co-presence

of opportunistic lung infections.¹ Of all patients presenting with pneumothorax, 2-5% are HIV positive.¹ Pneumocystis jiroveci pneumonia (PJP) was present in 29.5% of patients, bacterial pneumonia was found in 34.3%, and tuberculosis (TB) was found in 15.2%.² The treatment course for patients with HIV with pneumothorax is complicated due to the presence of sub-pleuritic necrosis and diseased lungs, which result in fragile lung tissue, leading to persistent air leaks and failure of lung expansion.³ Despite the successful resolution of pneumothorax being reported in 58% of cases, the recurrence rate was 71%.⁴ There was also high mortality rate of patients with pneumothorax and PJP reaching up to 50%.⁵ We have noticed in our clinical practice that patients with HIV who present with pneumothorax tend to have a more complicated treatment course in comparison to other patients. The aim of this study was to assess the prevalence, risk factors, and associated complications of pneumothorax that are present in patients with HIV at our institution and to provide an updated local study addressing the association between pneumothorax and HIV.

Methods. This retrospective cohort study examined patients with HIV who were admitted to King Saud Medical City in Riyadh, Saudi Arabia, from June 2017 to May 2022. The subjects were identified by the Medical Records registry. All patients with laboratory evidence of HIV above the age of 18 years were included in the study. The subjects were excluded if they were younger than 18 years old, had no laboratory evidence of HIV, had pneumothorax secondary to pigtail insertion, had chest tubes inserted for sub-cutaneous emphysema, or had chest tubes inserted outside our hospital.

A total of 161 patients were identified and were divided into 2 groups depending on the presence of pneumothorax diagnosis during their hospital stay. The following variables were studied between the 2 groups: age, gender, TB infection, PJP infection, bacterial pneumonia, need for mechanical ventilation, type of pneumothorax, site of pneumothorax, type of pneumothorax treatment, duration of the treatment, recurrence of pneumothorax, and any associated complications after treatment. All data were retrieved from the electronic healthcare records. The institutional review board of King Saud Medical City, Riyadh, Saudi Arabia, approved this research with an approval number H1RI-23-May22-01 and has complied with the Declaration of Helsinki. No consent was required due to the retrospective nature of the study.

Statistical analysis. The data were entered in Microsoft Excel and then exported to the Statistical

Package for the Social Sciences, Windows version 25.0 (IBM Corp, Armonk, NY, USA). Categorical variables are presented as frequencies and percentages, while continuous variables are presented as the means and standard deviations (SD). The relationships between variables were analyzed using the appropriate Chi-squared test or Fisher's exact test. All tests were 2-tailed, and the *p*-value was considered significant at the 5% level of significance.

Results. A total of 161 patients who were diagnosed with HIV and met the study's eligibility criteria were included. A total of 11 patients were diagnosed with pneumothorax. Of these 11 patients, 8 (72.7%) were males, and 3 (27.3%) were females. The mycobacterial infection result (TB and non-TB) was positive in 3 (27.3%) patients ($p=0.728$), while none were infected with PJP. Bacterial lung infection was found in 9 (81.8%, $p<0.001$) patients, while fungal infection was found in 6 (54.5%, $p=0.010$) patients. Mechanical ventilation was required for 10 (90.9%) patients (Table 1).

Simple pneumothorax was present in 6 (54.5%) patients, while tension pneumothorax was present in 5 (45.5%) patients. The mean age of onset of pneumothorax was 36.8 ± 13.9 years. Intercostal tube insertion was attempted for 9 (81.8%) patients, while conservative treatment was carried out for 2 (18.2%). The mean use duration of intercostal chest tube (ICT) was 39.3 ± 30.7 days.

Recurrence of pneumothorax was seen in one (9.1%) patient, while 3 (27.3%) patients had no recurrence of pneumothorax. The remaining 7 patients died with a chest tube, so the duration of chest tube use and recurrence of pneumothorax did not apply to those patients. Out of the 11 patients, only 3 (27.3%) are still alive, and the mortality rate was 72.7% ($p=0.007$). Out of the 3 living patients, thickened pleura with limited lung expansion was observed in 2 (18.2%) patients and broncho-pleural fistula developed in one (9.1%) patient (Table 2).

Out of the 150 patients with HIV and no pneumothorax, 103 (68.7%) patients were males, and 47 (31.3%) were females. Mycobacterial infection (TB and non-MTB) was found in 36 (24%) patients, while 2 (1.3%) patients were infected with PJP. Bacterial lung infection was found in 32 (21.3%) patients, while fungal infection was found in 27 (18%) samples. A mechanical

ventilator was required by 54 (36%) patients. Out of the 150 patients, 104 (69.3%) are still alive, and the mortality rate was 30.7% (Table 1).

Discussion. Pneumothorax in patients with HIV is more common than in general population. A study carried out in 2000 that included 599 HIV-infected patients showed that pneumothorax developed in 1.2% of the admissions and was most commonly related to iatrogenic causes, followed by bacterial pneumonia, positive pressure ventilation, and pneumocystis pneumonia.⁶ In our study, the prevalence of pneumothorax was 6.8%, higher than that reported in the literature.⁶

The presence of bacterial pneumonia was significantly related to the presence of pneumothorax ($p<0.001$), and fungal lung infections were found to be a vital risk factor for developing pneumothorax ($p=0.01$). In our study, the most common bacteria isolated in all groups were *Klebsiella pneumoniae*, *Acinetobacter baumannii*, and *Pseudomonas Aeruginosa*. In contrast, the most common fungal organisms were *Candida* species and *Aspergillus* species (Table 3). A study showed that almost 30% of those with pneumothorax were positive for lung TB,

Table 1 - Risk factors for pneumothorax in human immunodeficiency virus patients.

Parameter	With pneumothorax, n=11 n (%)	Without pneumothorax, n=150 n (%)	P-value
Age (mean \pm standard deviation)	36.8 \pm 13.9 years	-	-
Gender			
Female	3 (27.3%)	47 (31.3%)	1*
Male	8 (72.7%)	103 (68.7%)	
Bacterial infection			
Yes	9 (81.8%)	32 (21.3%)	<0.001
No	2 (18.2%)	118 (78.7%)	
Mycobacterium infection			
Yes	3 (27.3%)	36(24%)	0.728*
No	8(72.7%)	114 (76%)	
Tuberculosis infection			
Yes	3 (27.3%)	30 (20%)	0.698*
No	8(72.7%)	120(80%)	
Fungal infection			
Yes	6 (54.5%)	27(18%)	0.010*
No	5 (45.5%)	123 (82%)	
pneumocystis jiroveci pneumonia			
Yes	0	2 (1.3%)	1
No	11 (100%)	148 (98.7%)	
Mechanical ventilation			
Yes	10 (90.9%)	54 (36%)	<.001
No	1 (9.1%)	96 (64%)	
Outcome			
Alive	3(27.3%)	104 (69.3%)	0.007
Dead	8 (72.7%)	46 (30.7%)	

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Table 2 - Pneumothorax in human immunodeficiency virus group.

Parameters	n (%)
<i>Type of pneumothorax</i>	
Simple	6 (54.5%)
Tension	5 (45.5%)
<i>Treatment of pnx</i>	
ICT insertion	9 (81.8%)
Conservative	2 (18.2%)
<i>Site of ICT</i>	
Right	5 (45.5%)
Left	1 (9.1%)
Bilateral	3 (27.3%)
<i>Number of ICTs</i>	
Once	5 (45.5%)
Twice	3 (27.3%)
Three times	1 (9.1%)
Duration of chest tubes (mean±standard deviation)	39.3 ± 30.7 days
<i>Recurrence of pneumothorax</i>	
Yes	1 (9.1%)
No	3 (27.3%)
Not applicable	7 (63.6%)
<i>Complication</i>	
Thickened pleura with limited lung expansion	2(18.2%)
Broncho pleural fistula	1(9.1%)
None	9 (81.8%)

ICT: intercostal tube, PNX: pneumothorax

which has a complicated treatment course involving positive continuous air leaks in the drainage systems, as well as prolonged recovery and hospital stay.⁷ In our study, mycobacterial infection was found in 27.3% of those with pneumothorax, whereas the rate was 24% among those who did not develop pneumothorax ($p=0.728$). A study carried out over 6 years showed that 86% of patients who developed pneumothorax were positive for PJP, and the mortality rate reached up to 50%.⁵ Despite what was previously reported, there was no relation between PJP infection and pneumothorax in our study, as only 2 patients from the whole study group were found to be positive. Still, none of those 2 developed a pneumothorax ($p=1$; meaning that there is no significant evidence to reject the null hypothesis. The observed effects are likely due to random variability or chance).

In those with HIV, it has been reported that the duration of drainage is prolonged and is associated with a high recurrence rate and persistent air leak due to the destroyed lung parenchyma.¹ In our study, the mean duration of ICT use was 39.3 ± 30.7 days. This is almost 5 times higher than the normal population, as most patients (3 out of 4 patients) were positive for TB. Out of the 11 patients with pneumothorax, 10 (90.9%) patients required mechanical ventilation during their hospital stay. Along with other previously mentioned factors, pneumothorax due to barotrauma could be one of the contributing causes of the development and

Table 3 - Prevalence of lung infections.

Bacterial infections	With pneumothorax	Without pneumothorax
<i>Gram positive</i>		
Staphylococcus species	0	5
Streptococcal species	1	3
Corynebacterium species	0	1
<i>Gram negative</i>		
Enterobacter species	1	2
<i>Klebsiella</i> species	5	9
<i>Pseudomonas</i> species	2	8
<i>Escherichia coli</i>	1	2
<i>Acinetobacter baumannii</i> (MDRO)	2	10
<i>Citrobacter freundii</i>	1	1
<i>Stenotrophomonas maltophilia</i>	0	1
<i>Burkholderia cepacia</i>	0	1
<i>Proteus mirabilis</i>	0	2
<i>Delftia acidovorans</i>	0	1
<i>Mycobacterial infection</i>		
Mycobacteria tuberculosis (TB)	3	30
Mycobacterial infection other than TB	0	6
<i>Fungal infection</i>		
<i>Aspergillus</i> species	1	5
<i>Candida</i> species	6	25

worsening of pneumothorax.⁸ It was reported that the mortality rate of patients with HIV and pneumothorax was 30.8%, while those without pneumothorax had a mortality rate of 5.8%.¹ Out of the 11 patients with pneumothorax, 8 (72.7%) patients died, of which 2 patients ended up with complications after chest-tube removal, such as thickened pleura with limited lung expansion and broncho-plural fistula.

Study limitations. This study is limited by its retrospective nature and the small sample size. Not all patients underwent standardized investigations, and the tests were ordered by clinical suspicion. Most of the patients who tested positive for pneumothorax died before continuing their treatment course, which hindered the assessment of other possible complications that may have been present.

In conclusion, pneumothorax in patients with HIV is a manifestation of the progression of the disease and its poor outcome. The high prevalence of pneumothorax is mostly secondary to underlying lung infections. The course of pneumothorax treatment is complicated and is associated with a high mortality rate.

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