

The Correlation between Pleural Effusion Location with Pleural Fluid Analysis and Adenosine Deaminase Levels in Chronic Kidney Disease Patients Undergoing Hemodialysis

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Abstract- Pleural effusion is a common complication in chronic kidney disease (CKD) patients undergoing hemodialysis. This study aimed to evaluate the relationship between pleural effusion location with pleural fluid characteristics and adenosine deaminase (ADA) levels in hospitalized CKD patients. While ADA levels were higher in exudative effusions, no significant association was found between effusion location and pleural fluid composition. These findings suggest that effusion location alone is not a reliable diagnostic indicator in CKD patients.

Keywords: Pleural effusion; pleural fluid analysis; adenosine deaminase (ADA); chronic kidney disease (CKD); hemodialysis

I. INTRODUCTION

Pleural effusion is a common complication in patients with chronic kidney disease (CKD), particularly in those in severe stages undergoing hemodialysis. The underlying mechanisms involve fluid overload, infections, and inflammatory processes that alter pleural fluid characteristics. Differentiating between exudative and transudative effusions is crucial for determining the appropriate management and identifying potential underlying causes.

Adenosine deaminase (ADA) is an enzyme involved in purine metabolism and is commonly used as a biochemical marker in pleural effusion analysis. Elevated ADA levels are typically associated with exudative effusions, particularly in infectious and inflammatory conditions. However, in CKD patients undergoing hemodialysis, the role of ADA in pleural fluid remains less understood.

The location of pleural effusion has been suggested as a potential factor influencing pleural fluid characteristics, yet its association with ADA levels and pleural fluid analysis in CKD patients has not been well established. This study aims to assess the relationship between pleural effusion location with pleural fluid analysis, and ADA levels in hospitalized CKD patients undergoing hemodialysis. Understanding this relationship may provide further insights into the pathophysiology of pleural effusion in CKD and help in future patient management.

II. METHODS

This study utilized an observational analytic approach with a cross-sectional design, based on a review of medical records from hospitalized CKD patients undergoing hemodialysis with confirmed pleural effusion. Data included demographics, hemodialysis duration, pleural effusion location, fluid classification (exudative/transudative), and ADA levels. Associations were analyzed using chi-square and contingency correlation tests, with significance set at $p < 0.05$.

III. RESULTS

The study included predominantly elderly patients (≥ 60 years), with a higher proportion in females. Most had undergone hemodialysis for over one year. ADA levels varied, with a tendency toward higher values in exudative effusions. Pleural fluid analysis showed a mix of transudative and exudative effusions. Bilateral effusions were the most common. No significant relationship was found between pleural effusion location and pleural fluid analysis or ADA levels.

Table 1. Demographic characteristics

Variables		n (%) = 53
Age (years old)	< 30	4 (7.5)
	31 – 40	7 (13.2)
	41 – 50	12 (22.6)
	51 – 60	11 (20.8)
	> 60	19 (35.8)
Gender	Male	24 (45.3)
	Female	29 (54.7)
Duration of Hemodialysis	< 1 year	19 (35.8)
	≥ 1 year	34 (64.2)
	Mean $\pm$ SD	18.3 $\pm$ 30.19
ADA levels	0 – 30	42 (79.2)
	> 30	11 (20.8)
Pleural Fluid Analysis	Exudative	27 (50.9)
	Transudative	26 (49.1)
	Bilateral	23 (43.4)
Location of Pleural Effusion	Unilateral Dextra	15 (28.3)
	Unilateral Sinistra	15 (28.3)

Table 2. Relationship between pleural effusion location and pleural fluid analysis

Pleural Effusion Location	Pleural Fluid Analysis		p-value
	Exudative	Transudative	
Bilateral	10 (37%)	12 (50%)	0.689
Dextra	9 (33.4%)	6 (23.1%)	
Sinistra	8 (29.6%)	7 (26.9%)	
Total	27 (100%)	26 (100%)	

Table 3. Relationship between pleural effusion location and ADA levels

Pleural Effusion Location	ADA levels		p-value
	0 - 30	> 30	
Bilateral	18 (43.2%)	5 (44.4%)	0.886
Dextra	12 (29.5%)	2 (22.3%)	
Sinistra	12 (27.3%)	4 (33.3%)	
Total	42 (100%)	11 (100%)	

IV. DISCUSSION

The findings of this study shows that pleural effusion in CKD patients undergoing hemodialysis is more common in the elderly population, with a higher prevalence among female patients. This demographic trend may be influenced by the increasing incidence of CKD with age and the longer life expectancy of women with kidney disease. The majority of patients had been on hemodialysis for over a year which aligns with previous reports underlining prolonged dialysis as a risk factor for pleural effusion due to fluid overload, inflammation, or uremia-related complications.

Pleural fluid analysis revealed a mix of transudative and exudative effusions, suggesting multiple contributing mechanisms, including volume overload, infection, and inflammation. ADA levels tended to be higher in exudative effusions, consistent with its role in inflammatory and immune-mediated conditions. However, no significant relationship was found between pleural effusion location and pleural fluid characteristics. This finding suggests that pleural effusion in CKD patients is likely influenced by other systemic factors rather than the specific anatomical location of the effusion itself. Similar findings in previous studies supported the notion that pleural effusion location does not reliably indicate the difference between exudative and transudative effusions.

Overall, these results highlight the complexity of pleural effusions in CKD patients, emphasizing the need for a comprehensive diagnostic approach that considers multiple clinical and biochemical parameters rather than the location of the effusion alone.

V. CONCLUSION

To conclude, pleural effusion in CKD patients undergoing hemodialysis is more prevalent in elderly and female patients, with a predominance of those on long-term dialysis. While pleural fluid analysis showed a mix of transudative and exudative effusions, ADA levels were higher in exudative effusions, reflecting inflammatory processes. However, no significant relationship was found between pleural effusion location and pleural fluid characteristics or ADA levels, suggesting that effusion distribution is not a reliable determinant of its underlying pathology. These findings emphasize the need for a comprehensive diagnostic approach beyond effusion location to accurately assess pleural effusion etiology in CKD patients.

REFERENCES

1. Kugasia IR, Kumar A, Khatri A, Saeed F, Islam H, Epelbaum O. Primary effusion lymphoma of the pleural space: Report of a rare complication of cardiac transplant with review of the literature. *Transpl Infect Dis*. 2018; e13005. doi:10.1111/tid.13005.
2. Yalcin NG, Choong CKC, Eizenberg N. Anatomy and pathophysiology of the pleura and pleural space. *Thorac Surg Clin*. 2013;23(1):1-10. doi:10.1016/j.thorsurg.2012.10.008.
3. Tian P, Qiu R, Wang M, et al. Prevalence, causes, and health care burden of pleural effusions among hospitalized adults in China. *JAMA Netw Open*. 2021;4(8):e2120306. doi:10.1001/jamanetworkopen.2021.20306.
4. Porcel JM, Light RW. Pleural effusions. *Dis Mon*. 2013;59(2):29-57. doi:10.1016/j.disamonth.2012.11.002. PMID: 23374395.
5. Centers for Disease Control and Prevention (CDC). Chronic kidney disease (PGK) surveillance system: 2021. 2021.
6. Jabbar A, Qureshi R, Nasir K, Dhrolia M, Ahmad A. Transudative and exudative pleural effusion in chronic kidney disease patients: A prospective singlecenter study. *Cureus*. 2021 Oct 10.
7. Virupakshappa V, et al. Profile of pleural effusion in chronic kidney disease patients undergoing hemodialysis. *Indian J Immunol Respir Med*. 2017;2(4):103- 107.
8. Pertiwi A, et al. Dampak hemodialisis terhadap fungsi paru penderita penyakit ginjal kronik dengan hemodialisis rutin di RS H. Adam Malik dan. 2015.
9. Xiao J, Ge J, Zhang D, Lin X, Wang X, Peng L, Chen L. Clinical characteristics and outcomes in chronic kidney disease patients with tuberculosis in China: A retrospective cohort study. *Int J Gen Med*. 2022;15:6661-6669. doi:10.2147/IJGM.S367090. PMID: 36016982; PMCID: PMC9398214.
10. Light RW. Pleural effusions. *Med Clin North Am*. 2011;95(6):1055-1070. doi:10.1016/j.mcna.2011.08.005.
11. Li Y, Chen Z, Yang P, Duan H, He J, Gong L, Zhao L. Differentiating between tuberculous and non-tuberculous pleural effusions using the pleural fluid ratio of 10× adenosine deaminase/lactate dehydrogenase. *J Thorac Dis*. 2023 May 30;15(5):2627-35. doi:10.21037/jtd-23-383. Epub 2023 May 29. PMID: 37324069; PMCID: PMC10267918.
12. Seo HM, Kim M, Kim H. Refractory exudative pleural effusion in patients with chronic kidney disease not receiving dialysis: A case report. *Clin Case Rep*. 2019;7(4):675-9. doi:10.1002/ccr3.2069
13. Lee J, Park JE, Choi SH, Seo H, Lee SY, Lim JK, Yoo SS, Lee SY, Cha SI, Park JY, Kim CH. Laboratory and radiological discrimination between tuberculous and malignant pleural effusions with high adenosine deaminase levels. *Korean J Intern Med*. 2022;37(1):137-45. doi:10.3904/kjim.2020.246.

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