Original Article

Evaluation of abnormal Chest X-rays for hemodialysis patients

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Abstract

Background: A chest x-ray is the most practical way to evaluate lung disease. There are different degrees of pulmonary abnormalities in hemodialysis patients. The diagnosis of pulmonary disease in hemodialysis patients can be challenging due to the complex findings and multiple manifestations.

Objective: This study aimed to identify and evaluate the accuracy and consistency of chest radiographs in the diagnosis of pulmonary abnormalities in hemodialysis patients, Also highlight the limitations of CXR for diagnoses. **Materials** and methods: We collected and reviewed chest radiographs of 60 hemodialysis patients with various pulmonary manifestations. Two experienced radiologists independently interpreted CXR uptake to diagnose pulmonary disease. The degree of incompatibility among radiologists was assessed using SPSS statistical analysis (chi-square test**).Results**: The two radiologists showed slight agreement in pneumonia (29.6%), pleural effusion (28.6%), pulmonary edema (25.0%) and cardiomegaly (20.0%). Where the level of disagreement between radiologists 1 and 2 was in cardiomegaly (80.0%), pulmonary edema (75.0%)), pneumonia (70.4%) and pleural effusion (71.4 %). The total level of agreement was 31.7% and 63.3% disagreement. This result indicates that there is a significant difference in terms of diagnosis ($X2 = 8.067$, p-value <0.05).**Conclusion**: The chest X-ray upon admission is limited in accurately diagnosing pulmonary abnormalities in hemodialysis patients, primarily due to the presence of multiple diseases in the same patient and the increased occurrence of pulmonary edema in these patients. This poses a challenge to diagnosis without clinical data or the utilization of other imaging techniques.

Introduction

Chest x-ray is the most common and practical radiographic procedure performed in medical imaging departments. The advantages of a chest x-ray are that it is available in many healthcare settings, it is non-invasive, simple, and relatively inexpensive [1]. Chest x-ray is used to evaluate the lungs, heart and thoracic viscera. in addition, disease processes such as cardio-pulmonary problems, pneumonia, heart failure, pleurisy and lung cancer are common indications. The radiologists responsibility is to diagnose an image of the chest and this cannot be accomplished suitably without adequate knowledge of chest anatomy and pathology [2].

The relationship between the lung and kidney is clinically important in both health and disease. Several complications related to the respiratory system occur in hemodialysis patients [1]. Pulmonary diseases are common among hemodialysis patients and can be identified through different radiographic manifestations. However, the most frequent abnormality seen on chest radiographs in these patients is excess fluid causing pulmonary edema. Hemodialysis can also lead to thoracic complications primarily related to vascular access. The chest radiograph may show abnormalities arising from pulmonary lesions. The diagnosis of pulmonary disease in hemodialysis patients can be challenging due to the complex findings and multiple manifestations that often arise simultaneously. Understanding the different types of pulmonary disease that can occur in these patients can aid in determining the correct diagnosis and providing timely treatment [3,4].

Hemodialysis patients are particularly susceptible to volume overload and pulmonary edema, which can complicate the diagnosis. Pulmonary edema can imitate pneumonia, both in terms of an abnormal CXR and similar clinical symptoms [5]. This study aims to identify and evaluate the accuracy and consistency of CXR in the diagnosis of pulmonary abnormalities in hemodialysis patients, Also highlight the limitations of CXR for diagnoses.

Material and methods

A cross-sectional study was conducted in patients In the Radiology Department at Zawia Kidney Hospital to study a group of adult hemodialysis patients with chronic kidney disease (CKD). The study included a total of 60 male and female patients, aged between 18 and 76 years, who had previously undergone chest X-rays. The medical records of these hemodialysis patients, registered between February 2022 and September 2022, were analyzed. The aim was to diagnose any pulmonary diseases based on the interpretation of the chest X-ray results by two experienced radiologists. The radiologists evaluated the presence of any abnormalities in the lungs without having access to previous imaging or the patient's medical history. It should be noted that the radiologists were aware that the patients were undergoing hemodialysis. The data obtained from this study was analyzed using

9

the chi-square test in the SPSS statistical package.

Results

The study was conducted on 60 patients (29 females and 31 males), where the mean age of patients was 44.63 for a comparison evaluation between 2 radiologists .descriptive statistics has been

used to analyze the data by Statistical Packages (SPSS 25) which include: percentages, bar charts, Frequencies.

Table 1: shows that 51.7% of the sample study is male, while 48.3% of the sample study is female. This indicates that the sample was approximately equally distributed between males and females.

Table 1: Distributed sample based on Gender

Gender	Count	%
Male	31	51.7%
Female	29	48.3%
Total	**60**	**100.0%**

Mean age of the study population was 44.63±13.88 years (mean ±SD). The Majority were of the age 40 years to 59 years (55%). Table 2

Table 2: Distributed sample based on Age group

Age Group	Count	%	Mean	Std	Grand Mean	Std
Less than 20	4	6.7%	15.75	4.50	44.63	13.88
20-39	16	26.7%	32.81	4.64		
40-59	33	55.0%	49.09	5.57		
60 or older	7	11.7%	67.14	6.01		
Total	60	100.0%				

The sample distribution of radiologists' diagnoses based on gender shows some incompatibility with positive disease in males 50.0% by radiologist 1 and 40% by radiologist 2. While the compatibility with

positive disease in female were 48.3% by two radiologists. This result indicates that there are some variations between radiologists in terms of disease diagnosis based on gender. Table 3

Table 3: Distribution of Radiologist diagnosis with gender

Gender	Radiologist 1				Radiologist 2			
	Positive		Negative		Positive		Negative	
	Count	%	Count	%	Count	%	Count	%
Male	30	50.0%	1	1.7%	24	%40.0	7	11.7%
Female	29	48.3%	0	0.0%	29	48.3%	0	0.0%

Total	59	98.3%	1	1.7%	53	88.3%	7	11.7%

The two study radiologists agreed that 6.7% under the age of 20 were diagnosed with positive disease. also shows slight agreement at the ages of 20 and 39 and had a positive disease diagnosis of 26.7% by radiologist 1 and 25.0% by Radiologist 2. In addition, 53.3% were between the ages of 40 and 59 and diagnosed with positive disease by radiologists1 while 45.0% by radiologist 2. The agreement in 11.7% of patients were aged 60 years or older and were diagnosed with positive disease by radiologist 1 and radiologist 2. This result suggests that there are some differences in the diagnosis of diseases by radiologists according to age groups. Table 4

Table 4: Distribution of Radiologist diagnosis with age group

Gender	Radiologist 1							Radiologist 2
	Positive		Negative		Positive		Negative	
	Count	%	Count	%	Count	%	Count	%
< 20	4	6.7%	0	0.0%	4	6.7%	0	0.0%
20-39	16	26.7%	0	0.0%	15	25.0%	1	1.7%
40-59	32	53.3%	1	1.7%	27	45.0%	6	10.0%
>=60	7	11.7%	0	0.0%	7	11.7%	0	0.0%
Total	59	98.3%	1	1.7%	53	88.3%	7	11.7%

Based on the type of disease diagnosed by two radiologists, pneumonia was the highest percentage (38.3%) by radiologist 1, followed by cardiomegaly (21.7%) by radiologist 2, and pulmonary edema (13.3%) by radiologist 1, Subsequently pleural effusion (8.3%) by radiologist 2. Table 5

Table 5: Type of disease that was diagnosed by Radiologist 1 and Radiologist 2

Diagnosis	Radiologist 1		Radiologist 2	
	Count	%	Count	%
Normal(No)	1	1.7%	7	11.7%
Pneumonia (Pn)	23	38.3%	12	20.0%
Pulmonary edema (P.E)	8	13.3%	7	11.7%
Cardiomegaly (Car.)	5	8.3%	13	21.7%
Pneumothorax (Pnx.)	3	5.0%	5	8.3%
Pleural effusion (P.E.)	4	6.7%	5	8.3%
Acute bronchitis (A.Br.)	1	1.7%	1	1.7%
Cardiomegaly + Pneumothorax (Car&Pnx)	2	3.3%	3	5.0%
Pneumothorax + bronchitis (Pnx.&Br.)	1	1.7%	0	0.0%
Cardiomegaly +Aorta Aneurysm (Car.&A.A)	1	1.7%	0	0.0%

11

Cardiomegaly + Pneumonia (Car.&Pn)	4	6.7%	3	5.0%
Cardiomegaly + Pulmonary edema(Car.&P.E)	3	5.0%	1	1.7%
Pneumonia + Pleural effusion (Pn&P.E.)	1	1.7%	1	1.7%
Pneumonia + bronchitis (Pn&Br)	1	1.7%	0	0.0%
Pulmonary edema + Pleural effusion (P.E.&P.E)	1	1.7%	0	0.0
Pneumonia + Aorta Aneurysm (Pn&A.A.)	0	0.0%	1	1.7%
Pulmonary edema + Pneumothorax (P.E &Pnx)	0	0.0%	1	1.7%
Cardiomegaly + Pneumonia + Pleural effusion (Car&Pn&P.E.)	1	1.7%	0	0.0
Total	**60**	**100.0%**	**60**	**100.0%**

The radiologists showed slight agreement in pneumonia (29.6%), pulmonary edema (25.0%) pleural effusion (28.6%) and cardiomegaly (20.0%). The level of disagreement between radiologists 1 and 2 was in pneumonia (70.4%), pulmonary edema (75.0%), pleural effusion (71.4 %) and cardiomegaly (80.0%). Chart 1,2
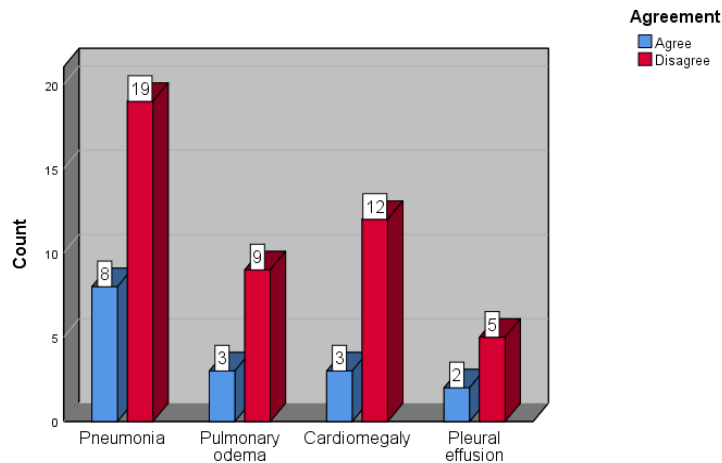

Chart 1: Comparison between radiologists 1 and 2 in terms of disease diagnosis.
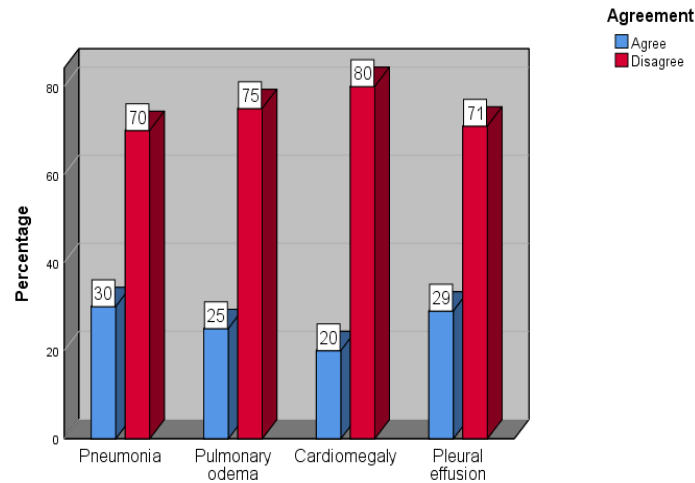
Chart 2: Comparison between radiologists 1 and 2 in terms of the percentage of disease diagnosis

Table 6: Comparison between Radiologists 1 and 2 in terms of disease diagnosis

Agreement	Count	%	Chi square value	P-value
Agree	19	31.7%	8.067	0.005
Disagree	41	68.3%		
Total	**60**	**100.0%**		

The total agreement shows that 31.7% of the diagnosis were agreed by radiologist 1 and 2, while 68.3% of the diagnosis were disagreed by radiologist 1 and 2. This result indicates that there is a significant difference between radiologist 1 and radiologist 2 in terms of diagnosis ($X2 = 8.067$, p- value< 0.05). Table 6
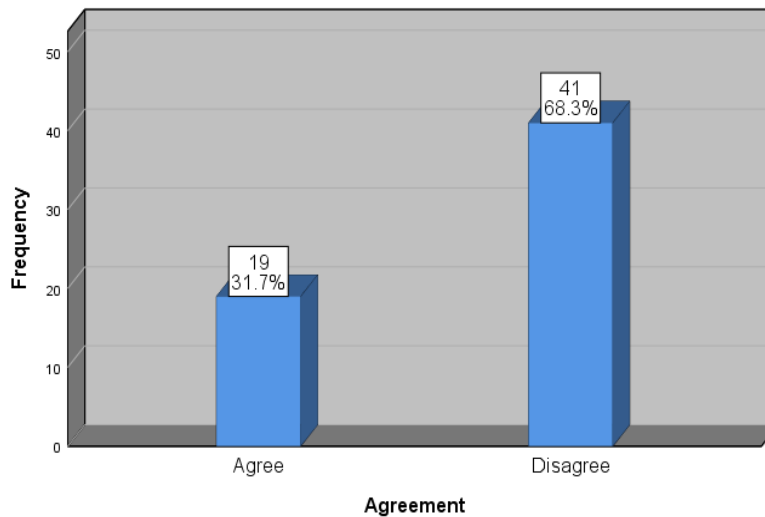
Chart 3: Comparison between radiologists 1 and 2 in terms of disease diagnosis.

Discussion

This study was conducted in (60) hemodialysis patients. There were 31 males (51.7%) and 29 females (48.3%). Chest X-rays have been an essential method that would help in identifying many diseases such as pneumonia, pulmonary edema, and pleural effusion. To assess the diagnosis and estimate the accuracy and consistency of the CXR in diagnosing pulmonary diseases in hemodialysis patients, and highlight the limitations of CXR for diagnoses. In this study, where two experienced radiologists interpreted chest radiographs in 60 patients, the radiological finding by radiologist 1 (38.3%) diagnosed pneumonia, while (20%) by radiologist 2. Pneumonia is difficult for radiologists to detect on a chest X-ray. The manifestation of pneumonia on X-rays is often blurred, may overlie with other diagnoses, and imitate many other abnormalities. These differences lead to significant differences in how radiologists diagnose pneumonia [6,7].

Pulmonary edema was diagnosed in (13.3%) by a radiologist 1 and (11.7%) by a radiologist 2, with

slight agreement. Hemodialysis patients are mostly disposed to volume overload and pulmonary edema, which can confuse the diagnosis of pneumonia. When CXR is abnormal, pulmonary edema may imitate pneumonia. Pulmonary edema and pneumonia occur in a large proportion because it is one of the most common manifestations in hemodialysis patients, hence pulmonary edema is associated with pneumonia [5,6].

Pleural effusion is ordinary in CKD on hemodialysis and was the fourth most frequent pulmonary manifestation found in our study, presented in (6.7%) by radiologist 1 and (8.3%) by radiologist 2 which represent a small percentage and slight agreement. As in the study conducted by Venkatesh Moger et al [4], pulmonary edema was found in (67%) patients, where the rate of incompatibility between two radiologists in pulmonary edema and pneumonia was (75.0%) and (70.4%). Respectively, where was the percentage of agreement between two specialists radiologists in pleural effusion

14

(28.6%), in the study conducted by Souvik Ray et al [9], it was found that pleural effusion was present in 29 out of 430 (6.7%), while the incompatibility rate between two radiologists in pleural effusion was (71.4%) and (51%) in the study conducted by Gülfidan Uzan et al [10].

Cardiomegaly represented (8.3%) by radiologist 1 and (21%) by radiologist 2 in our study. hemodialysis patients already suffer cardiomegaly which correlates with the degree of kidney damage. In the study conducted by Pradiba Amadita et al, it was found that (73.3%) of the subjects suffer from cardiomegaly and (26.7%) do not show a picture of cardiomegaly in CXR. This concludes the majority of the subjects had cardiomegaly and CKD is significantly correlated with the incidence of cardiomegaly [11,12].

From the Comparison between radiologist 1 and radiologist 2 in terms of disease diagnosis, we concluded that the level of agreement in pneumonia (29.6%), pulmonary edema (25.0%), pleural effusion (28.6%) and cardiomegaly (20.0%). The level of disagreement between radiologists 1 and 2 was in pneumonia (70.4%), pulmonary edema (75.0%), pleural effusion (71.4 %) and cardiomegaly (80.0%). Also, The total compatibility for all pulmonary manifestations in

our study for the diagnosis between radiologists 1 and 2 was 31.7%, while 68.3% of the diagnoses were incompatible. This result indicates that there is a significant difference between radiologist 1 and radiologist 2 in terms of diagnosis ($X2$ = 8.067, p-value < 0.05). Chart 3

Conclusion

In this study, it is reported that a significant number of hemodialysis patients have respiratory diseases. Specifically, pneumonia and pulmonary edema are commonly diagnosed in these patients. The variance in compatibility rates between radiologists 1 and 2 can be attributed to the presence of multiple diseases in the same patient's chest x-ray (CXR) and increased occurrence of pulmonary edema in these patients. This results in interference and blurring of the image of CXR, especially for hemodialysis patients, which makes it difficult for radiologists to diagnose without previous images to compare with or access the patient's clinical history and files. Consequently, this leads to differing diagnoses. It should be noted that other diagnostic imaging techniques may provide clearer results for these patients.

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