

# Bacteriological Profile of Pneumopathies in Chronic Renal Failure at the University Hospital Center of Point-G in Mali

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## Abstract

**Introduction:** Chronic renal failure (CKD) is defined as a glomerular filtration rate (GFR) of less than 60 ml/min/1.73m<sup>2</sup> for more than 3 months [1]. Infectious complications are a major source of morbidity in patients with chronic renal failure. In Mali, we have no data on pneumopathies in this population, hence the interest of this study. The objective of this work was to determine the frequency of pneumopathies in patients with chronic renal failure, describe the clinical radio-types, identify the microorganisms involved, and assess the renal prognosis of pneumopathies. **Materials and Methods:** This was an 18-month prospective and descriptive study from January 1, 2018 to June 30, 2019 conducted in the nephrology and hemodialysis department of the University Hospital of Point G. Included were patients hospitalized during our study period with CKD associated with pneumopathy on a chest X-ray. Not included were all patients hospitalized outside the study period, all CKD cases without pneumonia, patients with incomplete records, and non-consenting patients. **Results:** We examined 1111 patients, 35 of whom presented an image on chest X-ray related to pneumopathy, a frequency of 3.15% of cases. Twenty-one men (60%) and 14 women (40%) with a sex ratio of 1.5. The mean age was 46.8 ± 13.9 years with extremes of 23 and 76 years. The types of pneumopathy on the chest X-ray were: alveolar pneumopathy: 23 cases (65.7%), pleuropneumopathy: 10 cases (28.6%) and cavitary pneumopathy: 2 cases (5.7%). Cytobacteriological sputum examination was positive in 65.7%; leukocytes (68.6% of cases). The germs found were: *Klebsiella*

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*pneumoniae* (25.7% of cases), *Escherichia coli* (11.4%), *Pseudomonas aeruginosa* (5.7%), *Staphylococcus aureus* (5.7%), *Citrobacter freundii* (5.7%), *Enterococcus* sp. (2.9%), *Enterobacter cloacae* (2.9%), *Candida albicans* (5.7%). The search for acid-alcohol-resistant bacilli (BAAR) in sputum was positive in 4 cases (11.4%). There was an association between the results of cyto-bacteriological examination of sputum and the results of BAAR testing of sputum ( $p = 0.046$ ).

## Keywords

Renal Failure, Dialysis, Pneumopathy, Mali

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## 1. Introduction

Chronic renal failure (CKD) is defined as a glomerular filtration rate (GFR) of less than 60 ml/min/1.73m<sup>2</sup> for more than 3 months [1].

Infectious complications are a major source of morbidity in patients with chronic renal failure [2]. In a prospective study on a cohort of 1455 patients with chronic renal failure in France, the frequency of infectious episodes was 39 per 100 patient-years [3] [4]. In the same study, the frequency of pneumopathies was about 13 episodes per 100 patient-years, compared to only 1.5 episodes per 1000 subjects per year in France in the general population. In the HEMO study conducted in the United States on a cohort of 1846 hemodialysis patients, 42.4 p. 100 of the patients were hospitalized at least once in 34 months for a serious infection, and the incidence of pneumonia was 21% [5].

Pneumopathies are a frequent, serious and often difficult to diagnose etiologically in patients with chronic renal failure. Because of their frequency, severity and specific links with reduced immune defences, pneumopathies of infectious origin are the first cause to be mentioned. However, non-infectious etiologies can be a difficult differential diagnosis [6]. The identification of the microorganisms in question requires urgent further exploration. The urgency of anti-infectious treatment generally requires presumptive treatment oriented according to the immune deficiency involved and the etiological suspicion. The objective of this work was to determine the frequency of pneumopathies in patients with chronic renal failure, to describe the radio-clinical lesions, to identify the microorganisms involved and to evaluate the renal prognosis of the pneumopathies.

## 2. Materials and Methods

This was an 18-month prospective and descriptive study from January 1, 2018 to June 30, 2019 conducted in the nephrology and hemodialysis department of the G-spot University Hospital. It covered patients hospitalized for chronic renal failure, whether or not they were on hemodialysis, who presented with pneumopathy during that period, regardless of sex, age and nationality. Not included

in the study were all patients hospitalized outside the study period, all cases of chronic renal failure without pneumopathy, patients with incomplete records, and non-consenting patients.

The material consisted of the hospitalization register, hospitalization records, an individual survey form with sociodemographic data, clinical summaries, results of additional examinations, management and surveillance measures.

Chronic renal failure is defined as a progressive and irreversible decrease in GFR below 60 ml/min/1.73m<sup>2</sup> for at least 3 months, whether or not associated with other markers of renal impairment (proteinuria, hematuria, morphological or histological abnormalities).

Pneumopathy is an infection of the respiratory system and lungs.

There are several types of pneumopathy:

**Alveolar pneumopathy:** Alveolar syndrome consists of opacities characterized by one or more of the following radiological criteria:

- systematicized lobar or segmental distribution;
- blurred boundaries;
- tendency to confluence;
- broncho gram and/or aerial alveologram;
- divided into butterfly wings.

**Interstitial lung disease:** This is defined as the set of radiological signs indicating an injury to the interstitial area of the lung. The pulmonary interstitium is the connective tissue supporting the lung. It is divided into three sectors, the peripheral sector, the axial sector and the alveolar walls. Involvement of the peripheral area results in subpleural edema and Kerley lines A or B. Involvement of the peribronchovascular axial area results in peribronchovascular hilifugal opacities and erasure of vascular contours in the hilar and para-hilar regions.

**Nodular Pneumopathy:** Characterized by micronodular opacities or miliary images. These opacities are round, 1 to 3 mm in diameter, generally uniform in size and with relatively sharp contours.

**Bronchial pneumopathy:** This is a symptom of parietal thickening, dilation of the lumen and abnormal accumulation of secretions in the bronchial tubes.

Parietal thickening is characterized by ring-shaped images with more or less thick walls and parallel linear opacities drawing tube-shaped clefts.

**Cavity or excavated lung disease:** This is defined by the presence of one or more cavities in the lung. A lung cavity is a circumscribed parenchymal hyperclearness, *i.e.* surrounded by a wall of variable thickness. Excavation or cavitation is the appearance of a cavity

Sociodemographic (age, sex, occupation, ethnicity, provenance), clinical (interview and physical examination), biological and radiological data were collected from all patients. These data were collected through a comprehensive clinical examination and additional biological and radiological examinations.

The parameters studied were:

- In the blood: CBC, blood ionogram, serum calcium, serum phosphorus, se-

rum creatinine, C-reactive protein (CRP) and procalcitonin.

- In the urine: The cyto-bacteriological examination of urine (ECBU) in search of a urinary infection (leukocytes  $\geq 10,000/\text{ml}$ ) with or without hematuria  $\geq 10,000/\text{ml}$ , a bacteriuria  $\geq 100,000/\text{ml}$ ).
- In the sputum: The sputum cyto-bacteriological examination (ECBC) will look for leukocytes  $\geq 10/\text{mm}^3$ , red blood cells  $\geq 10/\text{mm}^3$ , the presence or not of the germ ( $10^5/\text{mm}^3$ ). The search for acid-alcohol-resistant bacilli (BAAR) will confirm the presence of BK (Bacille of Koch).
- Medical Imaging: X-ray of the front chest to look for pneumopathy, whether alveolar, interstitial, bronchial or other, and assess the cardiac condition.

Verbal informed consent was obtained from patients after explanation of the purpose of the study. In order to ensure the confidentiality of the results, the anonymity of medical records was strictly respected.

Data processing was performed on Microsoft office 2017 software, data entry and analysis on the SPSS20. The statistical test used was Chi-square with  $P < 0.05$  significance value.

### 3. Results

We examined 1111 patients, 35 of whom presented an image on chest X-ray related to pneumopathy, a frequency of 3.15% of cases.

Twenty-one men (60%) and 14 women (40%) with a sex ratio of 1.5. The mean age was  $46.8 \pm 13.9$  years with extremes of 23 and 76 years.

The medical history of our patients were: hypertension: 26 cases (74.3%), diabetes: 4 cases (11.4%), HIV: 3 cases (8.6%), tuberculosis: 3 cases (8.6%), hypertension plus diabetes: 2 cases (5.7%), sickle cell disease: 1 case (2.9%) and malaria: 1 case (2.9%).

The functional signs were: cough (100%), dyspnea (94.3%). The physical signs were: crackling rales (88.6%), suppression of vesicular murmur (17.1%), sibilants (5.7%), fever in 57.1% of cases (Cf. **Table 1** and **Table 2**).

The types of pneumopathy on the chest X-ray were: alveolar pneumopathy: 23 cases (65.7%), pleuropneumopathy: 10 cases (28.6%) and cavitary pneumopathy: 2 cases (5.7%) (Cf. **Table 3** and **Figures 1-3**).

Cytobacteriological examination of sputum was positive in 65.7%; leukocytes (68.6% of cases). The germs found were: *Klebsiella pneumoniae* (25.7% of cases), *Escherichia coli* (11.4%), *Pseudomonas aeruginosa* (5.7%), *Staphylococcus aureus* (5.7%), *Citrobacter freundii* (5.7%), *Enterococcus* sp. (2.9%), *Enterobacter cloacae* (2.9%), *Candida albicans* (5.7%) (Cf. **Table 4**).

The search for acid-alcohol-resistant bacilli (BAAR) in sputum was positive in 04 cases (11.4%). There was a statistically significant relationship between the results of cyto-bacteriological examination of sputum and the results of finding ASPB in sputum ( $p = 0.046$ ) (See **Table 5**).

Infectious and/or inflammatory parameters: increased CRP (100%), hyperleukocytosis (60%), leukopenia (5.7%), increased procalcitonin (65.7%).

The molecules tested and sensitive were Ceftazidim (37.1%), Ciprofloxacin (22.9%), Amoxicillin-clavulanic acid (17.1%), Gentamicin (17.1%), Meronia (11.4%), Zaxter (8.6%) and Erythromycin (2.9%).

There was a urinary co-infection in 40% of cases. The germs isolated in uroculture were *E. coli* (17.1%), *S. aureus* (5.7%), *Enterococcus* sp. (5.7%),

**Table 1.** Distribution of patients according to functional signs.

Functional signs	Staff	Percentage
Cough	35	100
Dyspnea	33	94.3
Vomiting	33	94.3
Physical Asthenia	31	88.6
Epigastralgia	30	85.7
Anorexia	29	82.9
Signs of arterial hypertension	27	77.1
Muscle cramps	27	77.1
Insomnia	26	74.3
Other functional signs*	11	31.4
Edematous syndromes	20	57.1
Constipation	12	34.3
Epistaxis	11	31.4
Anorexia	4	11.4
Diarrhoea	4	11.4
Haematodesis	4	11.4
Lumbar pain	4	11.4

One hundred percent (100%) of the patients had a cough. \*Other functional signs: convulsion (2), rectorragie (2), uremic breath (3), orthopnea (1), tremulation (3).

**Table 2.** Distribution by pulmonary signs.

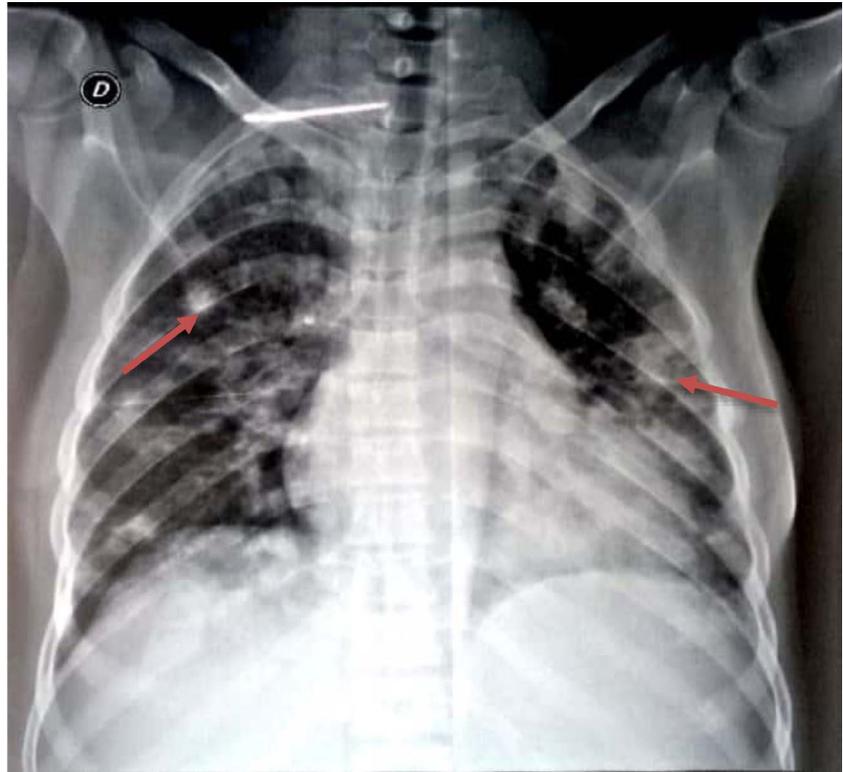
Lung signs	Staff	Percentage
Crackling rales	31	88.6
Abolition of vesicular murmurs	6	17.1
Sibilants	2	5.7

Thirty-one patients had crackling rales.

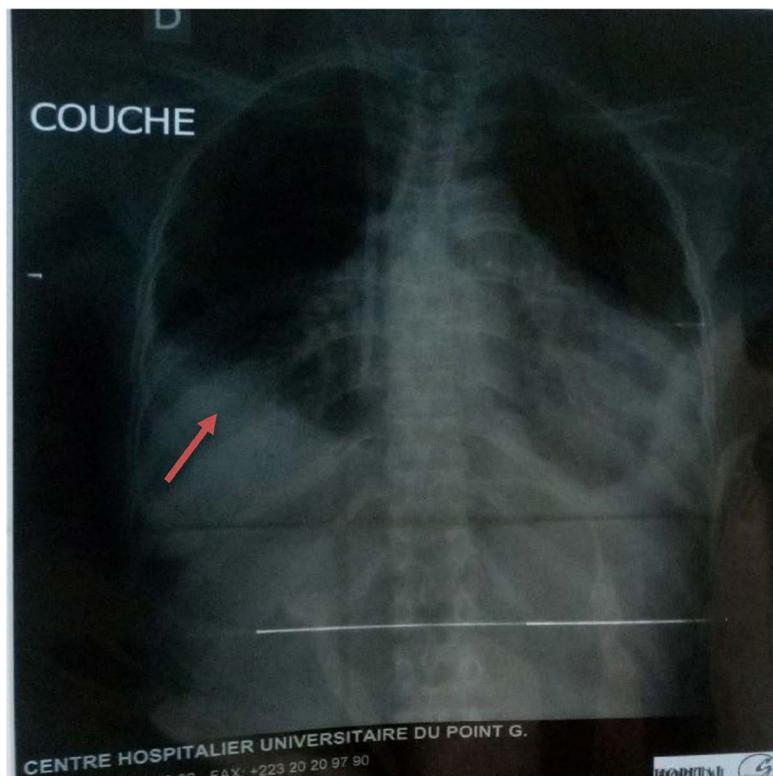
**Table 3.** Distribution by type of pneumopathy on chest x-ray of the frontal chest.

Result on the frontal X-ray	Staff	Percentage
Alveolar pneumopathy	23	65.7
Pleuropneumopathy	10	28.6
Cavitory lung disease	2	5.7

Alveolar pneumopathy was found in 65.7% of cases.



**Figure 1.** X-ray of the frontal thorax showing multiple diffuse alveolar opacities in the 2 pulmonary fields with blurred contours and aerial bronchograms.



**Figure 2.** Frontal chest X-ray objectivizing bilateral pleurisy with alveolar opacities of the right lung (Pleuropneumopathy).



**Figure 3.** Frontal thoracic radiograph showing a heterogeneous opacity of the left upper lobe associated with a voluminous left apical excavated opacity: aspect of a cavitary pleuro-pneumopathy.

**Table 4.** Spit-up distribution by germ isolated at ECBC.

Germes	Staff	Percentage
<i>Klebsiella pneumoniae</i>	9	25.7
<i>Esherichia coli</i>	4	11.4
<i>Candida albicans</i>	2	5.7
<i>Pseudomonas aeroginosa</i>	2	5.7
<i>Staphylococcus aureus</i>	2	5.7
<i>Citrobacter freundii</i>	2	5.7
<i>Enterococcus sp.</i>	1	2.9
<i>Enterobacter cloacae</i>	1	2.9
Sterile	12	34.3

*Klebsiella pneumoniae* was isolated in 25.7% of cases.

**Table 5.** Breakdown by outcome of BAAR search in sputum.

BAAR search in spit	Staff	Percentage
Negative	31	88.6
Positive	4	11.4
Total	35	100

Pulmonary tuberculosis was diagnosed in 4 cases or 11.4% of patients.

*Acinetobacter baumani* (2.9%), *Klebsiella pneumoniae* (2.9%), *Pseudomonas aeruginosa* (2.9%), *Candida albicans* (2.9%). There was no statistically significant relationship between germs found on cytobacteriological examination of sputum and cytobacteriological examination of urine ( $p = 0.576$ ).

The main etiologies of chronic renal failure in our study were hypertensive (37.2%), glomerular (20%), tubulo-interstitial (14.3%), ischemic (11.4%), diabetic (8.6%) and of undetermined cause (8.6%) of cases.

The evolution under treatment of pneumopathy was favourable in 74.3% with sputum sterilization (28.6%), normalization of CRP and procalcitonin in 48.8% and 31.4% respectively. The control chest X-ray was normal in 37.1% of cases. On the renal level, the evolution under treatment of pneumopathy was marked by the regression of the stigma of renal damage (creatininemia and blood urea) in 57.1% of cases, stabilization of renal function in 14.3% and 9 cases of death.

#### 4. Discussion

Limitations of the study: patients whose records were incomplete due to lack of financial means to carry out radiological and biological explorations, their return home against medical advice, non-consent and the occurrence of death contributed to reducing our workforce.

During the study period, there were 1111 patients who were diagnosed with CKD. Among them 35 patients presented an image of pneumopathy on a chest X-ray of the face, *i.e.* 3.15%. This frequency in Togo and Algeria was 5.4% and 12.2% respectively in 2017 [7] [8]. In a study in France, the frequency of pneumonia was about 13 episodes per 100 patient-years, compared to only 1.5 episodes per 1000 subjects per year in the general population [3] [4]. The incidence of bacterial pneumopathy was 34% in the study by Rieu Ph [9]. In the HEMO study conducted in the United States on a cohort of 1846 hemodialysis patients, 42.4% of the patients were hospitalized at least once in 34 months for a serious infection, and the incidence of pneumonia was 21% [5].

The sample consisted of 21 men (60%) and 14 women (40%), with a sex ratio of 1.5. Studies in Togo and Morocco reported male dominance in 60% and 59.1% of cases respectively [7] [9]. The mean age was  $46.8 \pm 13.9$  years with extremes of 23 and 76 years. Maiga in Togo reported an average age of  $51.87 \pm 16.7$  years [7].

All patients were given a complete clinical examination, particularly pleuro-pulmonary. The functional signs found were, in order of increasing frequency: productive cough (100%), dyspnea (94.3%). Physical examination revealed crackling rales (88.6%), suppression of vesicular murmurs (17.1%), sibilant rales (5.7%), fever (57.1%). These results are similar to those of Ouldittou in Morocco, which reported cough with sputum in all cases with crackling rales (70%), suppression of vesicular murmurs (30%) and fever in 84% of cases [9].

The types of pneumopathy on the chest x-ray were: alveolar pneumopathy (65.7%), pleuropneumopathy (28.6%) and cavitory pneumopathy (5.7%). Oul-

dittou in Morocco had alveolar-type opacity in all cases on facial radiography: unilateral in 76% of cases and bilateral in 24% of cases. Bacterial pneumopathies were common in elderly subjects with an age range of 56 - 65 in 37.2% of cases. Compared to Maïga in Togo, Bahri in Algeria, Ouldittou in Morocco and Fekih Hassen M *et al.* who reported a predominance of pneumopathies in subjects aged 55, 53, 50 and 56 years respectively [7] [8] [9] [10]. Lung disease was present in dialysis and non-dialysis patients in 77% and 23% of the cases in our series, respectively. Twenty-two out of twenty-seven (22/27) patients on dialysis had alveolar pneumopathy while in the non-dialysis patients pleuropneumonia was observed in six out of eight. A study carried out in Fez [11] in haemodialysis patients noted a frequency of bacterial pneumopathy of 2.49%. The susceptibility of uremic patients to infections is not only explained by increased exposure to the risk of infection, but also by the immune disorders involved in this phenomenon. Uremia is accompanied by abnormalities in innate and adaptive immunity [2] [12].

The sputum cytobacteriological examination (ECBC) was positive in 65.7% of cases with the presence of leukocytes in 68.6% of cases. The germs found were: *Klebsiella pneumoniae* (25.7% of cases), *Escherichia coli* (11.4%), *Pseudomonas aeruginosa* (5.7%), *Staphylococcus aureus* (5.7%), *Citrobacter freundii* (5.7%), *Enterococcus* sp. (2.9%), *Enterobacter cloacae* (2.9%), *Candida albicans* (5.7%) and 12 sterile cases. Previous antibiotic therapy is found in 34.3% of cases. This may explain the bacteriological negativity in the 12 patients. In the literature, Fekih Hassen [10] found a germ in 15 cases, including 9 pneumococci, 4 gram-negative bacilli, 2 gram-positive cocci. Bahri in Algeria in 2017 found *Klebsiella pneumoniae* as the most common germ in 16% of cases [9]. Contrary to the ECBC results of Fekih Hassen in Tunisia in 2014, which found *Streptococcus* (43%), *Haemophilus influenzae* (18%), *Staphylococcus aureus* (13%), *Acinetobacter baumannii* (12%) and *Klebsiella pneumoniae* (2%) in the cases [10]. Bahri in Algeria and Zaoui F in Tunisia also reported a predominance of Enterobacteriaceae in 71.3% and 40.80% of cases, respectively [8] [13].

There was a urinary co-infection in 40% of cases. Sprouts isolated in uroculture were *Escherichia coli* (17.1%), *Staphylococcus aureus* (5.7%), *Enterococcus* sp. (5.7%), *Acinetobacter baumannii* (2.9%), *Klebsiella pneumoniae* (2.9%), *Pseudomonas aeruginosa* (2.9%), *Candida albicans* (2.9%). There was no statistically significant relationship between germs found on cytobacteriological examination of sputum and cytobacteriological examination of urine ( $p = 0.576$ ). An epidemiological study conducted at the Ibn rochd UHC, which included 3933 patients from various hospital departments, observed the prevalence of enterobacteria with an equal frequency of *E. coli* and *Klebsiella pneumoniae* in patients with both pneumonia and urinary tract infection [14].

All our patients benefited from the exploration of the BAAR in sputum, 4 cases were positive (11.4%). Patients with both tuberculosis-associated lung disease and tuberculosis accounted for 2.9%. There was an association between the re-

sults of cytobacteriological examination of sputum and the results of BAAR testing of sputum ( $p = 0.046$ ). In a study of chronic hemodialysis in Mali [15] the incidence of pulmonary tuberculosis was 10.52%. In Morocco [16], the incidence of pulmonary tuberculosis in haemodialysis was 21%.

CRP was positive in all cases, procalcitonin was increased in 65.7% of patients and hyperleukocytosis was revealed in 60% of cases. Ouldittou found hyperleukocytosis in 66.4% of cases [9].

The severity of these chronic kidney diseases results mainly from the abolition of the kidney's ability to perform its excretory functions; metabolic disorders and hydroelectrolytic disturbances may then appear and threaten the renal and vital prognosis [4]. When the diagnosis of bacterial pneumopathy in chronic renal failure was made, the course of action was the initiation of antibiotic therapy sensitive to the isolated germ. The molecules tested and sensitive were Cef-tazidim (37.1%), Ciprofloxacin (22.9%), Amoxicillin-clavulanic acid (17.1%), Gentamicin (17.1%), Meronia (11.4%), Zaxter (8.6%) and Erythromycin (2.9%). Our results are in line with a study carried out in hospitalized patients with chronic renal failure in Morocco on pulmonary infections where the antibiotic prescribed as first-line treatment was a third-generation cephalosporin (50%), a ciprofloxacin (31.3%) and an aminoglycoside was associated in 22.9% [9]. Contrary to our study, Fakh Hassen in Tunisia in 2014 found in his study that the cephalosporin-quinolone association was the most prescribed [10]. Our patients received antibiotic therapy with an average treatment duration of 10.26 days. Tuberculosis cases were put on anti-tuberculosis drugs adapted to the residual renal function.

The evolution under treatment of pneumopathy was favourable in 74.3%, sputum sterilisation (28.6%), normalisation of CRP and procalcitonin in 48.8% and 31.4% respectively. The control chest X-ray was normal in 37.1% of cases. On the renal level, the evolution under treatment of pneumopathy was marked by the regression of the stigma of renal damage (creatininemia and blood urea) in 57.1% of cases and stabilization of renal function in 14.3%. Thus, it can be said that the presence of bacterial pneumopathy is an aggravating factor in these patients with chronic kidney failure. Infectious complications are the second leading cause of death in patients with deficiency [2]. We've recorded 09 deaths in our series.

## 5. Conclusion

Bacterial pneumopathies are common in nephrology. The radio-clinical lesions are varied. The germs involved are numerous. Bacteriological and radiological investigation must be systemic for early and effective management.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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