Pulmonary infection in the renal transplant recipients: Analysis of the radiologic manifestations

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Abstract

Purpose: To estimate the radiologic manifestations of pulmonary infection in the immunocompromised host of renal transplantation.

Materials and methods: This study was a retrospective view of the records of 29 adult renal transplant recipients developed pulmonary infection during December 2011 to July 2014 in our hospital. The chest radiographs and computer tomography (CT) examinations were interpreted by two radiologists independently.

Results: Pulmonary infections after renal transplantation were more likely to occur within 6 months after transplantation, and the peak being at about 3 months. Mixed infections (18 cases, 62.1%) were the common types, followed by virus infection (7 cases, 24.1%) and bacterial infection (4 cases, 13.8%). In 10 patients taken chest radiographs with pulmonary infections after renal transplantation, patchy shadow and/or increased lung markings were showed in 7 cases (70%). CT manifestations of pulmonary infections after kidney transplantation were diverse and complex, lacking characteristic signs. Ground glass opacity (GGO) was the most common CT manifestation in cytomegalovirus (CMV) infections.

Conclusions: The peak incidence of pulmonary infection is in the 3 months after renal transplantation and mixed infection is the most common. Correlating the radiologic manifestations with the clinical setting can expedite diagnosis and appropriate therapy.

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Keywords: Renal transplantation; Pulmonary infection; Ground glass opacity; Cytomegalovirus

1. Introduction

Renal transplantation has become a well-established therapeutic option for end-stage renal disease. The successful results are partially due to improved surgical and organ preservation techniques, but mainly to progress achieved in immunosuppressant therapy [1]. Immunosuppressant therapy is the reason why transplant recipients are exposed to greater infections risk. The lung is one of the most frequently involved organs in a variety of complications in the immunocompromised host [2,3]. Pulmonary Infectious complications markedly increase morbidity and mortality after renal transplantation [4]. The pathogens of pulmonary infection in the immunosuppressant host including the bacteria, fungus, virus and so on [5]. Although the radiologic manifestations of pulmonary infection in an immunocompromised host are often nonspecific and variable, chest radiography and computer tomography (CT) have an important role in diagnosis and therapy evaluation [6]. The aim of this study was to estimate the radiologic appearances of pulmonary infection in the immunocompromised host of renal transplantation.

2. Materials and methods

2.1. Patients data

For this retrospective analysis, data of 29 adult renal transplant recipients developed pulmonary infection during December 2011 to July 2014 in Peking University Third Hospital were collected. Ten patients had taken chest
radiographs and 19 patients had undergone chest CT scans. The 29 patients included 18 males and 11 females with a mean age of 40.0 ± 11.9 years.

2.2. Clinical data

The clinical diagnosis of pulmonary infection based on clinical respiratory symptoms and signs, imaging findings (chest radiography and/or CT), positive microbiological tests or pathologic findings, or effective clinical treatment trials. Clinical symptoms and signs included fever, productive cough, chest suffocation and dyspnea. Pathogenic examination included specimens (blood, sputum, throat swabs) culture for bacteria and fungus, serum concentrations measure for cytomegalovirus (CMV) antibodies (both IgM and IgG), and quantitative plasma polymerase chain reaction (PCR) for CMV DNA. The criteria for diagnosis referred to the Diagnostic Criteria for Nosocomial Infections formulated by the Ministry of Health in China [7] and the Diagnostic Criteria and Treatment Principles of Invasive Pulmonary Infections published in 2006 [8].

2.3. CT scan protocol

The patients were scanned by Siemens Healthcare SOMATOM Definition Flash Dual Source CT scanner. The routine chest CT images were obtained from the lung apices through the bases. Observation was made through the lung window (width 1600 HU, level -600HU) and the mediastinal window (width 400 HU, level 40 HU). The following CT parameters were used to acquire imaging data: thickness 1.0 mm, reconstruction interval 0.7 mm, pitch 1.05, collimation 128 × 0.6 mm, FOV 280 × 280 mm ~ 330 × 330 mm, 120 kV, quality ref. mAs 110, convolution kernel lung window B70f, mediastinal window B35f. CARE Dose 4D technique was applied. The acquired images were transmitted to GE AW4.5 workstation, and multiplanar reconstructions (MPR) were performed.

2.4. Radiologic analysis

The chest radiographs and CT examinations were retrospectively reviewed by two radiologists independently, who were blinded to the patient history. The findings and interpretations were based on their consensus opinion when there were disagreements. Chest radiographs were reviewed to determine the patchy shadow and increased lung markings. CT images were assessed to determine the consolidation, ground glass opacity (GGO), reticular or linear shadow, bronchiovascular bundle thickening, nodule/mass, tree-in-bud pattern, cavity and lymph node enlargement.

3. Results

3.1. Time characteristics of pulmonary infection after renal transplantation

Of all the 29 renal transplant patients, pulmonary infections occurred within one month after transplantation in 1 (3.4%) patient, 1–3 months in 16 (55.2%) patients, 4–6 months in 7 (24.1%) patients, 7–12 months in 1 (3.4%) patient, and more than 1 year in 4 (13.8%) patients. The pulmonary infections after renal transplantation were more likely to occur within 6 months after transplantation, and the peak being at about 3 months.

3.2. Pathogenic characteristics of pulmonary infections in renal transplant patients

Mixed infection (18 cases, 62.1%) was the most common, followed by virus infection (7 cases, 24.1%) and bacterial infection (4 cases, 13.8%). Mixed infection includes bacterial superinfection (1 case), bacterial co-infection with cytomegalovirus (CMV) (4 cases) or fungi (3 cases), fungi co-infection with CMV (5 cases), mycoplasma co-infection with CMV (1 case), and bacterial infection co-infection with fungus and CMV (2 cases), CMV co-infection with pneumocystis carinii (2 cases).

3.3. Radiological manifestations of pulmonary infections

In 10 patients taken chest radiographs with pulmonary infections after renal transplantation, chest radiographs showed patchy shadow and/or increased lung markings in 7 cases (70%).

In 19 CT examinations, GGO was the most common manifestation (14 cases, 73.7%), followed by bronchiovascular bundle thickening (11 cases, 57.9%), consolidation (8 cases, 42.1%), nodule (4 cases, 21.1%), tree-in-bud pattern (3 cases, 15.8%), reticular or linear shadow (2 cases, 10.5%), cavity (2 cases, 10.5%) and lymphadenectasis (2 cases, 10.5%) et al.

Of mixed infections, patchy shadows were seen in the all chest radiographs, and single lung distribution was noticed in only one case; Consolidation was the most common CT finding (Fig. 1), often accompanied with GGO, reticular or linear shadow, bronchiovascular bundle thickening and nodules.

Of single and mixed CMV infections, bilateral patchy shadows were found in all of the chest radiographs, and GGO was the most common finding seen in CT images (14 cases, Fig. 1. Axial CT image shows bilateral diffuse ground-glass opacities in a 46-year-old female after renal transplantation with CMV pneumonia and pneumocystis carinii pneumonia.
73.7%), accompanied with the patterns of consolidation, reticular or linear shadow, and bronchiovascular bundle thickening. Bilateral diffuse distribution was more common. There were 2 cases manifested as only GGO were CMV co-infection with pneumocystis carinii (Fig. 2).

Two of the 4 single bacterial infection cases had normal chest radiographs, one chest radiograph showed patchy shadows of both lungs, the rest one had GGO on the CT. Chest radiograph manifestations of 3 bacteria with fungus infections were bilateral patchy shadows, while CT images were consolidations with cavities. In 2 cases of bacteria, fungus complicated with CMV infection, CT showed consolidations were the main finding, accompanied with various manifestations.

4. Discussion

Pulmonary infection is the chief cause of death in the immunocompromised host of renal transplantation, and is associated with high morbidity and mortality. Rapid and accurate diagnosis of pulmonary infection is important, not only because of the high morbidity and mortality associated with infection but also because of the frequent complications associated with the drugs used to treat the infection [9]. The chest radiograph and CT are the essential diagnostic tools. In both images, the manifestations of the abnormality and the degree of progression can help the diagnosis. However, radiography alone is seldom adequate, because its findings are seldom specific for the detection of a particular pathogen. It is necessary to summarize the clinical characteristics and radiologic findings of the different pathogens in pulmonary infection after renal transplantation.

4.1. The susceptible time of pulmonary infection after renal transplantation

Some studies have proved that the most susceptible time of pulmonary infection after renal transplantation was the second and sixth month after transplantation [1]. In our study, it was the second and fourth month after renal transplantation, and the peak was the third month. Because the immunosuppression reaches maximum levels between the second and sixth month after renal transplantation, it would cause the pulmonary infection mostly.

4.2. The pathogens of pulmonary infection after renal transplantation

After renal transplantation, the most frequent infections are the opportunistic ones, allowing microorganisms like bacteria, fungus, virus and pneumocystis carinii, et al. Some study has proved that fever of unknown origin after renal transplantation may mostly due to CMV infection [10]. In our study, the mixed infection was the most, and CMV played an important role.

4.3. The radiologic manifestations of pulmonary infection after renal transplantation

CMV pneumonia is a common cause of mortality in renal transplantation recipients with a reported fatality rate of 65—90%. Therefore, early diagnosis, strategic prevention and active treatment of CMV pneumonia are crucial for renal transplantation success [11,12].

In CMV infection, CT may show patchy or diffuse GGO, consolidation, small centrilobular nodules, bronchial wall thickening, a combination of consolidation and reticular opacities, and pleural effusion [13]. In this study, GGO was the most common radiologic manifestation in CMV infection with or without other pathogens infection. It was consistent with the previous studies. In contrast, however, the main radiologic manifestation was consolidation with or without GGO in the mixed infections. Therefore, we think that GGO is a useful radiologic manifestation for the diagnosis for the CMV infection after renal transplantation.

In conclusion, renal transplantation is associated with a high risk of pulmonary infectious complication, which may lead to relevant consequences for patients’ morbidity and mortality. Correlating the radiologic manifestations with the clinical setting can expedite diagnosis and appropriate therapy.

References


