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Community-acquired pneumonia by *Legionella pneumophila* serogroups 1–6 in Brazil ☆

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Summary A prospective cohort study of adult patients hospitalized due to community-acquired pneumonia was carried out for 1 year in a Brazilian university general hospital to detect the incidence of community-acquired pneumonia by *Legionella pneumophila* serogroups 1–6. During a whole year, a total of 645 consecutive patients who were hospitalized due to a initial presumptive diagnosis of respiratory disease by ICD-10 (J00–J99), excluding upper respiratory diseases, were screened to detect the patients with community-acquired pneumonia. Fifty-nine consecutive patients hospitalized due to community-acquired pneumonia between July 19, 2000 and July 18, 2001, were included in the study. They had determinations of serum antibodies to *L. pneumophila* serogroups 1–6 by indirect immunofluorescence antibody test at the Infectious Diseases Laboratory of University of Louisville (KY, USA) and urinary antigen tests for *L. pneumophila* serogroup 1. Three patients had community-acquired pneumonia by *L. pneumophila* serogroups 1–6, two patients being diagnosed by seroconversion and positive urinary antigen tests; the other had negative serologies but strongly positive urinary antigen test. The incidence of community-acquired pneumonia by *L. pneumophila* serogroups 1–6 in our hospital was 5.1%.

Abbreviations: CAP, community-acquired pneumonia; COPD, chronic obstructive pulmonary disease; BAL, bronchoalveolar lavage; HRCT, high resolution computed tomography; CT, computed tomography; WHO, world health organization; CDC, center for diseases control; ELISA, enzyme-linked immunoabsorvent assay

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Background

Legionella infections are difficult to diagnose because the bacteria is not seen at Gram stain; culture may have a sensitivity of 26%,[1] reaching 80% at laboratories of excellence,[2] while for the direct fluorescent antibody test it may vary from 25% to 70%.[3] PCR techniques are still not recommended for clinical diagnosis.[4] The most used test has been serum antibody detection by immunofluorescence or enzyme-linked immunosorbent assay (ELISA), by demonstration of fourfold rise in the immunofluorescent antibody titer of greater than or equal to 1:128 against *Legionella pneumophila* serogroup 1 between paired acute- and convalescent-phase serum specimens, whose sensitivity ranges between 70% and 80%,[3] but can be as low as 36%.[1] The sensitivity of the *Legionella* urinary antigen test in a review ranged from 86% to 93%.[4] It has become a definitive criterion for the diagnosis of *Legionella* pneumonias,[5] being recommended to the diagnosis of community-acquired pneumonia that requires hospitalization.[6,7]

The incidence of *Legionella species* community-acquired pneumonia in many countries has ranged from 1% to 16%.[8] Such incidence has not been estimated in Brazil so far, also there is no report of the use of the *Legionella* urinary antigen test for the diagnosis of *Legionella* pneumonias. The aim of this study is to detect the incidence of community-acquired pneumonia by *L. pneumophila* serogroups 1–6 in hospitalized patients in a southern Brazilian general university hospital, and to report their clinical picture and evolution.

Methods and materials

This prospective study was approved by the institutional Committee of Ethics in Research. All consenting individuals with ages between 18 and 80 admitted to our university general hospital due to an initial presumptive diagnosis of respiratory disease by ICD-10 (J00–J99), excluding upper respiratory diseases, were screened to detect the patients with community-acquired pneumonia. They were enrolled in the study if their chest radiograph taken within 48 h of admission indicated pneumonia and had either one of the major criteria (axillary temperature $\leqslant 35.5\,^{\circ}C$ or $\geqslant 37.8\,^{\circ}C$, cough or sputum) or two of the minor criteria (dyspnea, abnormal mental status, signs of consolidation by examination, pleuritic chest pain, white blood count $>12\,000$ cells per cm^3 or band forms $>4\%$).

Underlying chronic disease was defined as presence of heart disease, liver disease, renal disease, lung disease or diabetes mellitus. Underlying disease with immunosuppression was defined as presence of HIV infection, splenectomy, hematological malignancy, autoimmune disorder, transplant recipients and receipt of cancer chemotherapy within 4 weeks[9] or prednisolone use of at least 10 mg/day (or equivalent doses of other steroids) in the last 3 months.[10]

Exclusion criteria were: residents in institutions, those disabled to walk, hospitalization in the preceding 15 days, pregnant women, HIV-positive patients, cystic fibrosis, patients with bronchiectasis or tracheostomy. Routine tests (chest radiograph, blood nitrogen, serum creatinine, erythrocyte sedimentation rate, sputum Gram stain and culture, blood cultures) were asked at the discretion of the attending doctor. Urine and serum samples were collected during the first week; and a second serum sample after 4–12 weeks. Radiological exams were all interpreted by an experienced radiologist (Ilha, DO) according to the thoracic radiology nomenclature.[11,12] Sera stored at $-70\,^{\circ}C$ were further sent on dry ice in a batch to the Infectious Diseases Laboratory of the University of Louisville (KY, USA) to be tested for IgG, IgM, and IgA serum antibodies to *L. pneumophila* serogroups 1–6 by indirect immunofluorescence antibody test (Zeus Scientific Inc., Raritan, NJ, USA), starting at 1:8. All the urine samples were frozen to be tested in batches at our laboratory using the kit *Legionella* urinary enzyme assay (EIA BINAX, Portland, ME, USA). A ratio $\geqslant 3$ in comparison to duplicate test samples with a negative control was considered positive. Positive urine samples were refrozen and further sent to the American laboratory to be confirmed by the same kit test.

Diagnostic criteria of *L. pneumophila* serogroups 1–6 acute infection were either a fourfold rise in antibody titer to at least 1:128 or positive urinary antigen test. The cumulative incidence of community-acquired pneumonia caused by *L. pneumophila* serogroup 1–6 in our university hospital for a year was calculated.

Results

During a whole year, 645 consecutive patients who were hospitalized due to an initial presumptive diagnosis of respiratory disease by ICD-10 (J00–J99), excluding upper respiratory diseases, were examined at hospital admission to exclude or confirm CAP. Most were not included due to reasons

given in Table 1. Only 82 patients were initially eligible to be studied with the diagnosis of CAP, from which group 23 patients were further excluded either because a new pulmonary infiltrate was not confirmed with chest radiograph (five patients) or alternative diagnoses were made (COPD, five patients; heart failure, three; tuberculosis, two; collagen vascular diseases, one; idiopathic pulmonary fibrosis, one. The other six patients had exclusion criteria by being HIV positive (one), presenting bronchiectasis (four) or previous pneumatocele (one). Thus, 59 patients constituted the final study group, being 20 women and 39 men, with a median age of 57.6 years (SD = 10.5). From this group, 36 (61%) pacients had underlying chronic diseases; 61% were smokers and 19% were imunosuppressed.

Only seven patients had some seropositivity to *L. pneumophila* serogroups 1–6 (Table 2). Two patients did not have convalescent samples due to death. Only two had seroconversion, thus being serologically proven cases of community-acquired pneumonia by *L. pneumophila* serogroups 1–6.

The serum sample of acute phase and the urine sample were collected in 54 out of 59 patients during the first week of hospitalization (media: 4.2 days; SD: 2.4 days). In the remaining five patients, they were collected after the 10th day.

The urinary antigen test was positive in only three patients (Table 3).The urine of patient 1 was collected on the first day of admission, while in patients 2 and 3 on the third and fifth day of admission, respectively. The first patient had his urine tested at our laboratory after it was stored in the freezer for 5 months; the second and third patient had his urine stored, respectively, for 3 and 2 months before being tested. After that, they were refrozen and kept in freezer for 4 more months before being sent to the Infectious Diseases Laboratory of University of Louisville (KY, USA), where only the urine samples of patients 1 and 2 were confirmed positives (Table 3).

Out of the 59 community-acquired pneumonia patients, 11 died, 7 being deaths due to pneumonia (11.9%). All our three patients with *L. pneumophila* serogroup 1–6 were cured.

Patient 1—A 63-year-old male, current heavy smoker with systemic hypertension consulted in the emergency room with axillary temperature of 39.5 °C, complaining of chills, cough and dyspnea which started 3 days before. Chest radiograph showed pneumonia in the inferior right lobe and in part of right middle lobe (Fig. 1). He was prescribed PO amoxicillin-clavulanate 1 gr q8 h in ambulatorial regimen but after 2 days he entered the hospital due to worsening of the symptoms, with diarrhea, yellow sputa and high-grade fever. Axillary temperature was 39.3 °C; white blood count 13.3/μl, segmented forms 78%, band forms 8%, lymphocytes 11%, monocytes 2%, metamyelocytes 1%; sodium serum concentration 127 mEq/l, SGOT 60 U/l, SGPT 38 U/l, alkaline phosphatase 374 UI/l, total bilirubin 1 mg/dl, direct bilirubin 0.5 mg/dl. Blood and sputum cultures were negatives. Auscultation revealed diminished breath sounds and rhonchi diffusely, and crackles over the right posterior lung, in the middle and inferior lung fields. He received IV ampicillin-sulbactam plus IV clarithromycin for 6 days, which were replaced by IV levofloxacin for 10 days due to allergic cutaneous reaction. After 5 days of treatment, despite antibiotic treatment and fever resolution, alkaline phosphatase had risen to 885 UI/l, SGOT to 188 UI/l and band forms to 16%. After 21 days of treatment, despite clinical and laboratorial improvement and a slight radiological regression, the lesions of the superior segment of the inferior right lung had progressed (Fig. 2), and a slight new consolidation had appeared in the superior right lobe which were both confirmed by a thorax computed tomography (CT), which also showed centrilobular emphysema (Fig. 3). A second thorax CT, 1 year later, showed complete resolution of the pneumonic lesions.

Patient 2—A 40-year-old female consulted in the emergency room with vomiting, axillary temperature of 38 °C, complaining of pleuritic chest pain in the left, dry cough, and worsening of dyspnea in the last 3 days. The patient took PO azathioprine 7.5 mg on an alternate-day regimen, chloroquine 250 mg/day and prednisone 60 mg/day for systemic lupus erithematosus and CREST syndrome. She took also PO captopril 100 mg/day to systemic hypertension. She also had chronic renal failure and anemia. She had been hospitalized 3 months back but no lung problems other than chronic intersticial pulmonary lesions due to collagen vascular disease were found. Chest radiograph showed bilateral bronchopneumonia (Fig. 4). She was prescribed PO amoxicillin-clavulanate 1 gr q8 h, but after 3 days she agreed to be hospitalized owing to persistent high fever. She had purulent, slightly blood-tinged sputa, fever of 38.6 °C and oral candidiasis. Auscultation revealed late inspiratory crackles in both inferior lung fields, as she used to present. Sputum and blood cultures were negative. Hematocrit 30%, hemoglobin 10 g/dl, white blood count 6100, band forms 10%, segmented forms 76%. Chest radiograph at admission showed a progression of the pneumonic lesions (Fig. 5). She was prescribed oral fluconazole plus IV levofloxacin for 14 days and discharged. A blood culture taken on the fourth day of hospitalization

Table 1 Exclusion criteria in 563 patients presenting presumed respiratory disease at hospital admission by ICD-10 (J00–J99), excluding upper respiratory diseases.

Exclusion criteria	*n*	%
(I) Patients immediately excluded		
1. <18 years old	42	7.5
2. ⩾80 years old	47	8.3
3. Hospital discharge in the preceding 15 days	27	4.8
4. Institutionalized patients, nursing home	2	0.3
5. HIV-positives at admission	18	3.2
6. Using tracheostomy	2	0.3
7. Cistic fibrosis	3	0.5
8. Hemiparesis	57	10.1
9. Paralysis of leg and foot	7	1.2
10. Bronquiectasis	7	1.2
11. Patients completely disabled to walk	14	2.5
Total	226	40.1
(II) Patients further examined who did not have any infiltrate in chest X-ray in the first 48 h		
1. Hypertensive crisis	1	0.2
2. Cirrosis (acute)	1	0.2
3. Renal failure	3	0.5
4. Stroke (acute)	1	0.2
5. Meningitis	4	0.7
6. Cancer	9	1.6
7. Febrile neutropenia	2	0.3
8. Alcohol withdrawal syndrome	1	0.2
9. Ketoacidosis	2	0.3
10. Shock or septicemia (lung not the primary source)	6	1.1
11. Diagnosis not known yet	158	28.1
Total	188	33.4
(III) Presumed pneumonia patients whose clinical or radiological criteria of pneumonia were not confirmed in the first week of hospitalization		
1. Pneumotorax	4	0.7
2. COPD only	23	4.1
3. Asthma exacerbation	7	1.2
4. TB (active)	26	4.6
5. TB (not active) with hemoptysis and/ or respiratory bacterial infection	2	0.3
6. Pleural effusion only	9	1.6
7. Pulmonary fibrosis	7	1.2
8. Lung tumor only	12	2.1
9. Sinus infection and bronchitis (acute)	2	0.3
10. Silicosis	1	0.2
11. Mitral stenosis	2	0.3
12. Acute pulmonary edema	2	0.3
13. MI	1	0.2
14. Congestive heart failure	10	1.8
15. Mediastinal mass	1	0.2
Total	109	19.4
(IV) Patients not examined		
1. Death in the first 24–48 h	12	2.1
2. Discharged in the first 24–48 h	16	2.9
3. Patients denying participation	3	0.5
4. Patients not available to be examined more than twice	9	1.6
Total	40	7.1
Total	563	100

Table 2 Patients with community-acquired pneumonia who presented seropositivity to *Legionella pneumophila* serogroup 1–6 by indirect immunofluorescence antibody test at the Infectious Diseases Laboratory of University of Louisville (KY, USA).

Patients initials	1st sample (acute phase)	2nd sample (convalescent phase)
1. ACB	<8	1024
2. SBG	<8	128
3. CAC	<8	32
4. MRS	16	—
5.WP	16	<8
6. CRCL	32	—
7. OJS	64	—

—Serum sample not obtained. <8 means Not Reagent at 1:8.

Table 3 Positive results of *L. pneumophilla* serogroup 1 test and serology results in three out of 59 patients hospitalized due to community-acquired pneumonia.

Patient initials/serology result	At Brazilian laboratory		At American laboratory	
	Result	Ratio	Result	Ratio
1. ACB/positive (seroconversion)	Positive	6.0	Positive	30
2. SBG/positive (seroconversion)	Positive	16.3	Positive	27
3. JPA/negative (not reagent at 1:8)	Positive	13.5	Negative	1.2

All the remaining 56 patients had negative urinary antigen tests.

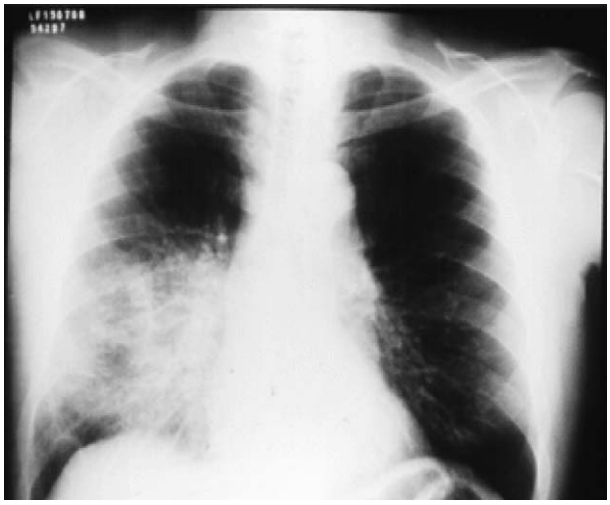

Figure 1 Chest radiograph of patient 1 showing large alveolar consolidations in the inferior right lobe (IRL) and in part of middle lobe.

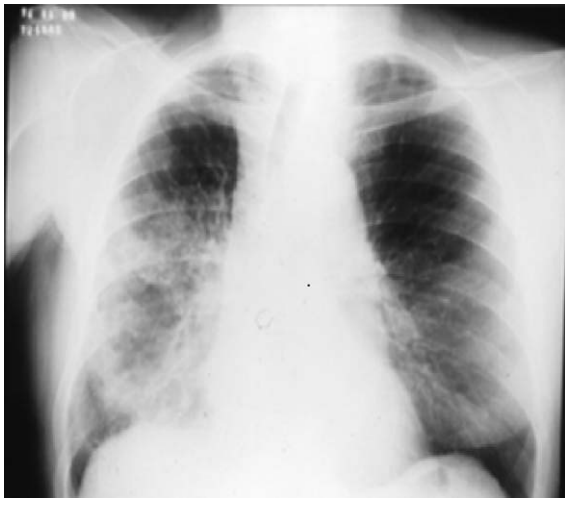

Figure 2 Chest radiograph of patient 1 after a 21-day-treatment with macrolides and levofloxacin showing that despite a slight regression of the opacities of the IRL and middle lobe, there was a progression of the lesions to the superior segment of IRL and a new consolidation in the superior right lobe.

yielded *Staphylococcus* sp. sensitive to penicillin, ampicillin, oxacillin, clindamycin and erythromycin. After 2 months a chest radiograph (Fig. 6) showed a significant regression of the infectious lung lesions. A concomitant high-resolution computed tomography of the thorax (HRCT) showed decreased pneumonic lesions and the interstitial chronic pulmonary lesions of collagen vascular disease.(Fig. 7). After 8 months, a new chest

radiograph showed an almost complete regression of the pneumonic lesions.

Patient 3—A 77-year-old male consulted in the emergency room complaining of coughing in the last 3 days and fever. He did not have history of respiratory diseases in the preceding year. The patient took PO levodopa and carbidopa for Parkinson's disease but no medication for diabetes. He had urine incontinence due to prostate enlargement. At admission he presented mental confusion and disorientation, axillary temperature of 38 °C and purulent sputum. Crackles were heard in his back, over the right inferior lung field. Chest radiograph presented pneumonia in the inferior right lung (Fig. 8). White blood count was in the normal range but band forms were 31%. His sodium serum concentration was 132 mEq/l, creatinine 1.5 mg/dl, glucose 417 mg/dl. He was prescribed IV ampicillin-sulbactam 1 gr q6 h with improvement of symptoms, being discharged after 8 days. Sputum culture was negative and urine culture yielded *Klebsiella pneumoniae* $>10^5$/ml sensitive to ampicillin. Chest radiograph showed no more pulmonary lesions after 4 months (Fig. 9).

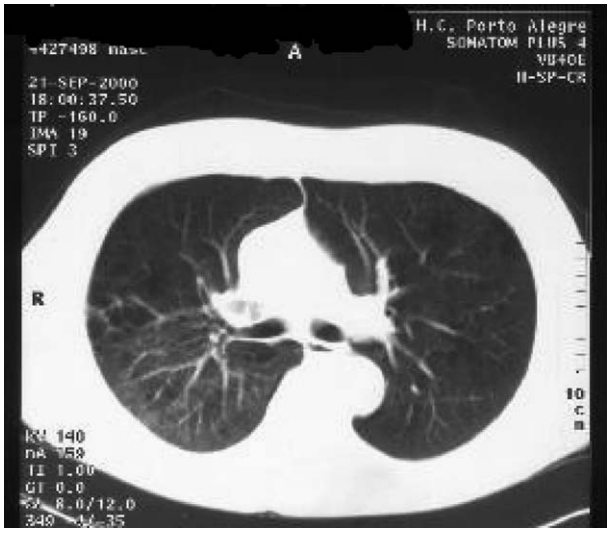

Figure 3 Thorax CT of patient 1 confirming the new consolidation in posterior segment of the superior right lobe.

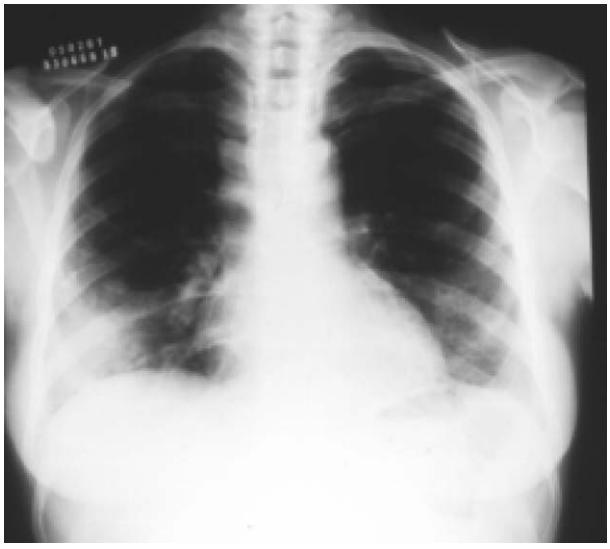

Figure 4 Chest radiograph of patient 2 showing patchy consolidations in both lower lobes.

Discusssion

As none of the diagnostic methods specific for *Legionella* is 100% sensitive[13] it is advised to use complementary diagnostic methods to the diagnosis of pneumonia caused by *Legionella species*.[14] The *Legionella* urinary antigen test has the best sensitivity among the available tests.[4,15] It has been increasingly used showing patients with positive results despite negative culture tests or non-diagnostic serologies.[15–17] Data for 1980–1998 from Center for Disease Control and Prevention (CDC) showed that the diagnosis of Legionnaires' disease by urinary antigen testing increased from 0% to 69%, overcoming the use of serological testing, probably due to the fact that its sensitivity is better than the other methods.[15] Between 1995 and 1999, 167 (79%) of all legionellosis cases notified in Australia were due to *L. pneumophila* serogroup 1, 69% being detected by urinary antigen test while only 31% by culture.[16]

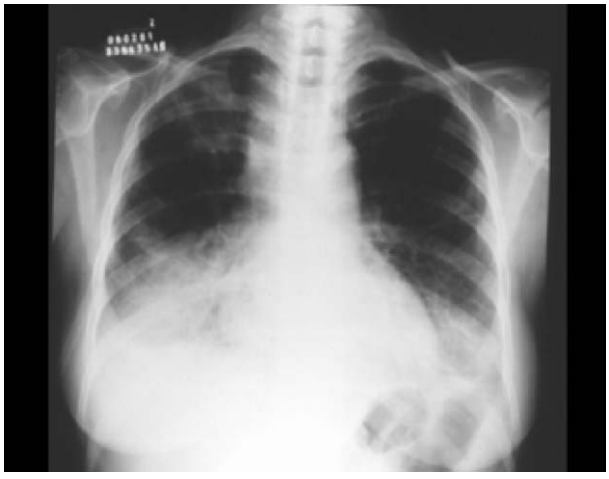

Figure 5 Chest radiograph of patient 2 after 4 days of ampicillin-clavulanate showing that the patchy consolidations increased bilaterally, mainly in the inferior right lobe, where they progressed to an extense alveolar pneumonia. There is also a new small patchy consolidation in the right upper lobe.

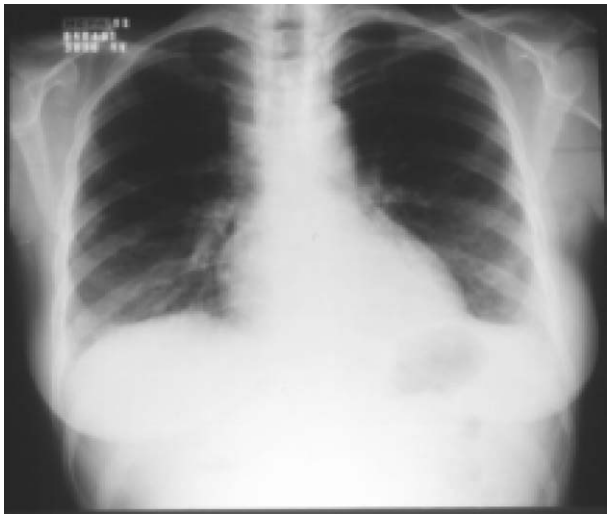

Figure 6 Chest radiograph of patient 2 60 days after levofloxacin treatment showing a significant regression of the infectious lung lesions.

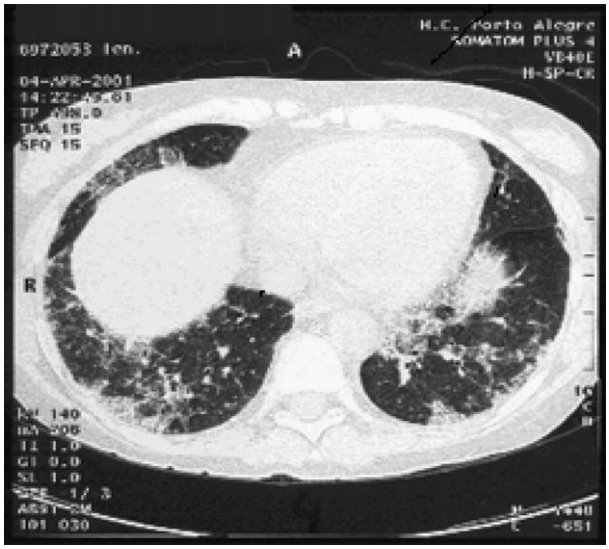

Figure 7 Thorax HRCT of patient 2 taken 60 days after levofloxacin treatment. There is still a small consolidation in the inferior left lung, which probably is the infectious pneumonia in regression. We can see interstitial lesions of collagen vascular disease: thickening of the interlobular septa, ground-glass opacities and small nodules.

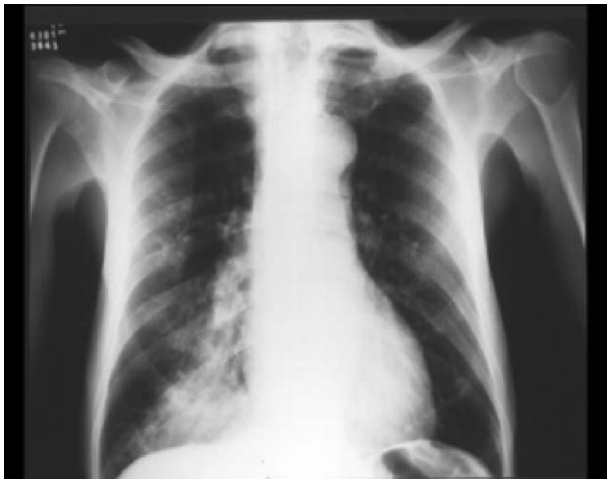

Figure 8 Chest radiograph of patient 3 at admission showing alveolar consolidation in the right lower lobe.

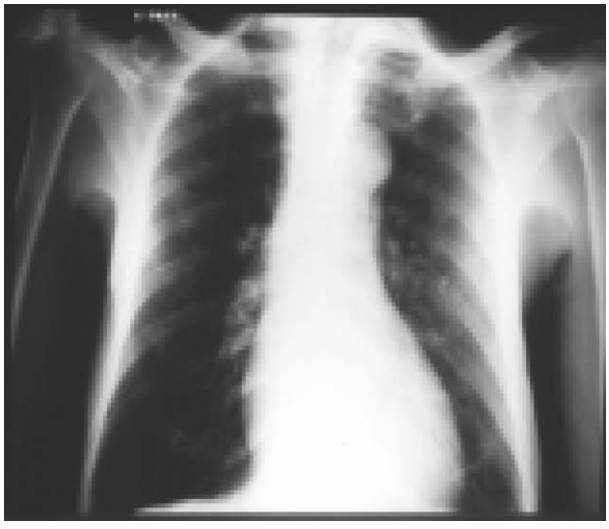

Figure 9 Chest radiograph of patient 3 showing no more pulmonary lesions after 4 months.

Most of studies on *Legionella* pneumonia in the last decade used urinary antigen tests along with other diagnostic methods.[1,10,17–22] Culture remains the ''gold standard'' for other diagnostic methods, but it is not widely used. A survey of hospital laboratories in US reported that 32% were incapable of growing the organism, even when given a pure culture.[23] As we do not perform culture to *Legionella* at our laboratory, we used serology and urinary antigen test to estimate the incidence of Legionnaires' disease in our hospital.

Both World Health Organization's (WHO)[24] and CDC case definitions for Legionnaires' disease[5] agreed that pneumonia patients who have a fourfold or greater rise in the reciprocal immunofluorescent antibody test titer of greater than or equal to 1:128 against *L. pneumophila* serogroup 1 between paired acute- and convalescent-phase serum specimens are confirmed cases of pneumonia by *Legionella*. WHO case definition considers that a pneumonia patient with a positive urinary antigen test has a ''probable'' or ''presumptive'' disease.[24] More recently, CDC case definitions for Legionnaires'disease[5] stated that patients with pneumonia who have positive results in urinary antigen to

L. pneumophila serogroup 1 by radioimunoassay or ELISA are confirmed cases of pneumonia by *Legionella*; also stated that the previously used category of ''probable'' case (which was based on a single immunofluorescent antibody titer greater than or equal to 1:256) shall not be used because elevated single titers of $\geqslant$256 against single or multiple *Legionella* antigens occurred in 12% of 184 normal control sera;[25] or high prevalence of positive antibodies at 1:256 has been reported in healthy populations,[26] so this very single titer lacks specificity for surveillance.[17] We adopted seroconversion of $\geqslant$1:128 as the serological criterium of definite infection by *L. pneumophila*, as well as a positive antigen urinary test, as recommended by CDC.

Only seven patients in our study presented seroreactivity to *L. pneumophila* serogroup 1–6 (Table 2); three out of seven had only the serum sample of acute phase to analysis, which were seropositives at low titrations. Some authors reported low positive titles ($<$1:64) in specimens from acute phase in most of their final 74 patients with confirmed legionellosis, while the serum samples of convalescent phase were $\geqslant$1:256 in 62%.[17] So, we cannot exclude *Legionella* etiology in these three patients. Other two seropositives patients in our study did not have a fourfold rise, then patients 1 and 2 (Table 2) are the only cases of *L. pneumophila* serogroup 1–6 serologically confirmed.

The acute-phase serum specimen of our third patient with *Legionella* community-acquired pneumonia was missed. We got two serum samples of convalescent phase, taken, respectively, 5 weeks and 12 weeks after the acute episode, both being not reagent ($<$1:8). In this case, the diagnosis was made by a positive urinary antigen test only like a noteworthy study[17] in which six patients had positive urinary antigen test and were considered eventually as true legionellosis patients. We wonder if our third patient would have had antibodies in the missed acute-phase serum specimen; if not, he might be included in the 20–30% group of patients with Legionnaires' disease who never develop antibody titer elevation.[27,28]

In our study three patients had pneumonia caused by *L. pneumophila* serogroup 1. Two patients had both seroconversion and positive antigen urinary test; the third patient had a positive urinary antigen with negative serologies. We advise every patient who has a positive urinary test to be carefully investigated as we did to rule out a past *Legionella* infection, in order to prevent misinterpretations of the test results.[29]

The urine sample of patient 3 was tested along with the urine of patient 2, after both were kept at $-70\,^{\circ}$C, respectively, for 2 and 3 months until we made the urinary antigen test in our laboratory. They were refrozen for 4 more months at $-70\,^{\circ}$C and tested again at the American laboratory. The ratio obtained there was 1.2 only, and since they did not know Brazilian laboratory's results, the third urine was interpreted as negative. We believe all our three positives urinary antigen tests are truly positives, including the high positive ratio obtained in our third patient (13.4). There is only one report of false positive urinary antigen test so far, in a patient who received rabbit sera, which reacted with the rabbit antibodies of the EIA Binax slides.[30] We believe that this urine became negative at the American laboratory due to its storage for more than 4 months, since a fall in the ratio of the *Legionella* antigen in urines kept 3–6 months in the freezer was already demonstrated;[31] and also 22% of 18 positive urine samples stored at $-70\,^{\circ}$C after 23–379 days became negatives when tested by the same EIA Binax kit we used in our patients.[32]

The incidence of *L. pneumophila* serogroups 1–6 infection in hospitalized patients with community-acquired pneumonia in our hospital in the year 2000–2001 was 5.1%, which represents the annual incidence of *Legionnaires*' disease in a general hospital of Southest Brazil.

Our three *L. pneumophila* community-acquired pneumonia patients had common characteristics of risk group individuals to *Legionella* infection: advanced age, smoking habit, chronic pulmonary diseases, immunosuppression.[8,33,34] Patient 1 presented a progression of the radiological lesions during specific antibiotics to *Legionella* despite clinical improvement, as reported.[2,28,35,36] Patient 1 and 2 worsened initially on beta-lactams, a classical finding;[2] while patient 3 improved and got cured only on beta-lactam antibiotics, like other recently reported patients,[28,35,37] adding to the evidences that in some cases *Legionella* pneumonia may be a self-limited disease which gets cured despite non-specific antibiotic therapy.

None of our patients with *Legionella* died despite having co-morbidities, immunodepression and advanced age; and despite the fact that no one received antibiotics to cover atypical bacteria initially. The worsening of the disease in the first two patients finally led to the recommended empirical treatment. Passive surveillance data reported that after 1990 legionellosis mortality decreased significantly,[15] probably due to the shift in the empirical treatment of community-acquired pneumonia ever since 1993, when it was

recommended that empiric therapy should cover *Streptococcus pneumoniae* and atypical bacteria.[7,38]

One weakness of our study is that we had to freeze urine samples to further test it in batches because the *Legionella* urinary test is not a routine at our hospital; so we wonder if any of the urine samples whose result was negative may have lost the antigen while waiting in the freezer to be tested in batches at our laboratory.

As a negative antigen urinary test in a patient with non-diagnostic serologies does not exclude legionellosis, other diagnostic methods should be always done to improve the diagnostic yield. We think we may have underestimated the incidence of this disease in our hospital, where the culture method is not available. The urinary antigen test does not replace the culture to the study of *Legionella* community-acquired pneumonia and nosocomial legionellosis as well,[39] rather is a very sensitive and prompt complementary diagnostic method to *L. pneumophila* infection, also being very useful to epidemiological purposes. We believe that the urinary antigen test must be available in the routine of every hospital to be performed in every patient with community-acquired pneumonia severe enough to require hospitalization, as our patients were hospitalized in the ward and did not require ICU treatment, as well in every patient who has risk factors of pneumonia by *Legionella*.

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