





BRIEF REPORT

PERITONITIS IN PERITONEAL DIALYSIS PATIENTS FROM A HOSPITAL IN LIMA, PERU

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ABSTRACT

In order to determine the rate and factors related to peritonitis in peritoneal dialysis (PD) patients treated at a hospital in Lima, Peru; a retrospective single-cohort study was conducted during the period 2014-2016. All patients diagnosed with chronic renal disease from the PD program at the Cayetano Heredia Hospital were included. The incidence rate of peritonitis was estimated and a bivariate analysis was performed to assess related factors. A total of 73 patients were included. The incidence rate of peritonitis was 0.60 episodes per patient per year; 46.7% of the cultures were positive and the most common isolated germ was *S. aureus*. Lower albumin and hematocrit values were found to be related to peritonitis. In this study, the incidence rate of peritonitis and negative cultures were found to be higher than the internationally estimated rate.

Keywords: Peritonitis, Peritoneal Dialysis, Risk Factors (Source: MeSH NLM).

INTRODUCTION

In Peru, the frequency of patients on renal replacement therapy (RRT) is 415 patients per million population, 88% of whom are on chronic hemodialysis (CHD), and 12% on peritoneal dialysis (PD)⁽¹⁾. PD is a type of RRT as effective as CHD in terms of survival and, it shows a better health-related quality of life during the initial period of the illness compared to CHD, even adjusted for clinical and socioeconomic variables⁽²⁾.

The first cause of PD failure is peritonitis; this complication causes the removal of the peritoneal catheter and the transition to CDH⁽³⁾. The possible factors related to the development of peritonitis in PD patients reported include obesity, hypo-albuminemia, depression, greater geographical distance between the patient's residence and dialysis unit, dialysis technique (lack of training, limited biosecurity), invasive interventions (colonoscopies, hysteroscopies), peritoneal catheter exit-site infections, nasopharyngeal colonization of *S. aureus*, etc.⁽³⁾.

In terms of the survival rate and health status, automated PD has not been shown to be superior to continuous ambulatory PD^(4,5); however, in terms of the relative risk of PD-associated peritonitis, the results are contradictory^(3,4,6). For a PD program, the frequency of infectious complications, local frequencies of peritonitis, microbiological profile, and resistance pattern need to be determined to guide clinical practice regarding treatment and prognosis⁽⁷⁾. Currently, there is little public information about the procedures or complications in PD programs Peru.

Thus, the aim of this study is to determine the incidence rate of peritonitis and related risk factors in adult patients in a PD program in Lima, Peru between 2014 and 2016.

THE STUDY

This is a single-cohort retrospective longitudinal study. All patients over 18 years of age, diagnosed with chronic kidney disease (CKD) and in the PD program at the Hospital Cayetano

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Heredia in Lima, Peru, between January 2014 and December 2016 were included. We excluded patients who began treatment at another PD center or who did not have the necessary information, i.e., laboratory values from the last three months. Three patients were excluded for the latter reason.

An episode of peritonitis was considered when patients presented at least two of the following criteria recommended by the International Society for Peritoneal Dialysis (ISPD)⁽³⁾: a) clinical characteristics related to peritonitis (abdominal pain or cloudy peritoneal effluent); b) leukocytes in peritoneal effluent $>100/\mu\text{L}$, with $>50\%$ polymorphonuclears (PMN); c) positive culture of peritoneal effluent. The peritonitis episode was classified according to the terminology established by ISPD as “recurrent”, “relapsing”, “repeat”, and “isolated”⁽³⁾.

Demographic, clinical, and laboratory information recorded by the PD program and medical records were collected. Regarding patient variables, data were recorded on age, sex, origin, educational attainment, employment, admissions, etiology of CKD, comorbidity, body mass index (BMI), type of PD, person performing dialysis, time on PD, number of hospitalizations for any reason, months since the last hospitalization, serum albumin value, hematocrit value, and patient destination after the episode of peritonitis.

For the peritonitis episodes, we recorded the time in PD, the cellularity of the peritoneal fluid (leukocytes and polymorphonuclear cells), the culture result, the type of peritonitis, the isolated microorganisms, the antibiotic sensitivity, the antibiotic treatment, the infection of the exit hole of the peritoneal catheter, the serum albumin value and the hematocrit nearest to the moment of diagnosis, BMI and destination. We used the values obtained at the time when the peritonitis diagnosis was made.

Summary and dispersion measures were used according to the distribution of the data obtained and compared between the groups of patients with peritonitis and without peritonitis. The incidence rate of peritonitis per patient per year, the incidence rate per patient per month, and the proportion of positive and negative cultures were determined. The analysis of factors related to peritonitis associated with peritoneal dialysis was evaluated per episode of peritonitis, rather than per participant; therefore, in some cases, patient-specific variable measures are repeated because some episodes occur in the same patient. The groups of patients with peritonitis and without peritonitis were compared by means of a bivariate analysis: chi-square for the qualitative

KEY MESSAGES

Motivation for the study: The number of peritoneal dialysis patients is increasing; however, there is little information about the complications associated with this type of dialysis in Peru.

Main findings: The incidence rate of peritonitis in peritoneal dialysis patients was 0.60 episodes per patient-year. The proportion of negative cultures was 53.3%. Both are above the internationally suggested limits. The factors related to peritonitis were lower albumin and hematocrit values.

Implications: Protocols to standardize peritoneal fluid collection and analysis, and studies with larger populations and follow-up time are required.

variables, Student's t test for the quantitative variables with parametric distribution and the Wilcoxon rank-sum test for the quantitative variables with non-parametric distribution.

The study project was previously approved by the Ethics Committee of the Universidad Peruana Cayetano Heredia. The information was analyzed without personal identifiers to preserve patient confidentiality.

FINDINGS

A total of 73 patients were included: their median age was 39.0 years (IQR 22-59), 58.9% of them were women, 67.6% lived in Lima, 38.2% had complete secondary education, and 27.8% had chronic glomerulonephritis as the most frequent etiology for CKD. The most frequent comorbidity was arterial hypertension with 56.0%, the most frequent modality of dialysis was manual (72.2%), performed in most cases (58.6%) by the same patient.

Serum albumin means and standard deviation (SD) in patients who developed peritonitis (3.19 mg/dL; SD 0.74) and in patients who did not develop peritonitis (3.58 mg/dL; SD 0.44) had a significant difference ($p = 0.041$). Similarly, the mean hematocrit in patients who developed (30.39%; SD 7.02) and those who did not develop peritonitis (34.39%; SD 6.35) had a significant difference ($p = 0.032$) (Table 1).

The average time on dialysis was 52.8 months (SD 32.9). Patients had an average of 1.1 hospitalizations (SD 1.1) (Table 1). At the end of the study period, 63.0% of the patients continued peritoneal dialysis.

A total of 114 episodes of peritonitis was recorded; 50 patients (68.5%) developed at least one episode of peritonitis during the study period. The incidence rate of peritoni-

Table 1. Characteristics of patients in the dialysis program at the Hospital Cayetano Heredia (2014-2016).

| Characteristic | Global (73) | Peritonitis (50) | No peritonitis (23) |
|--|---------------------|------------------|---------------------|
| | N (%) | n (%) | n (%) |
| Age | 39.0 (IQR 22-59) | 39,5 (RIQ 23-59) | 30,0 (RIQ 20-59) |
| Sex | | | |
| Women | 43 (58.9) | 31 (62.0) | 12 (52.2) |
| Men | 30 (41.1) | 19 (38.0) | 11 (47.8) |
| Provenience | | | |
| Lima | 48 (67.6) | 35 (70.0) | 13 (61.9) |
| Province | 23 (32.4) | 15 (30.0) | 8 (38.1) |
| Educational attainment | | | |
| Analphabet | 5 (9.1) | 2 (5.4) | 3 (16.7) |
| Incomplete primary school | 9 (16.4) | 6 (16.2) | 3 (16.7) |
| Complete primary school | 7 (12.7) | 7 (18.9) | 0 (0) |
| Incomplete secondary school | 9 (16.4) | 7 (18.9) | 2 (11.1) |
| Complete secondary school | 21 (38.2) | 14 (37.8) | 7 (38.9) |
| Superior | 4 (7.3) | 1 (2.7) | 3 (16.7) |
| Employment | | | |
| No | 30 (58.8) | 20 (60.6) | 10 (55.6) |
| Yes | 21 (41.2) | 13 (39.4) | 8 (44.4) |
| Financial income | | | |
| <1 MLW | 24 (66.7) | 17 (70.8) | 7 (58.3) |
| 1-2 MLW | 8 (22.3) | 4 (16.7) | 4 (33.3) |
| 2-3 MLW | 4 (11.1) | 3 (12.5) | 1 (8.3) |
| >3 MLW | 0 (0) | 0 (0) | 0 (0) |
| Etiology of chronic kidney disease | | | |
| Unknown | 16 (22.2) | 13 (26.0) | 3 (13.6) |
| Chronic glomerulonephritis | 20 (27.8) | 15 (30.0) | 5 (22.7) |
| Diabetic nephropathy | 8 (11.1) | 6 (12.0) | 2 (9.1) |
| Nephroangiosclerosis | 6 (8.3) | 5 (10.0) | 1 (4.5) |
| Others | 22 (30.5) | 11 (22.0) | 11 (50.0) |
| Comorbidities | | | |
| Arterial hypertension | 42 (56.0) | 31 (64.6) | 11 (50) |
| Diabetes | 7 (9.3) | 4 (8.3) | 3 (13.6) |
| Tuberculosis | 4 (5.3) | 4 (8.3) | 0 (0.0) |
| Obstructive uropathy | 4 (5.3) | 2 (4.2) | 2 (9.1) |
| Cardiopathy | 4 (5.3) | 4 (8.3) | 0 (0.0) |
| Others | 18 (24.0) | 12 (25) | 6 (27.3) |
| PD type | | | |
| Manual | 52 (72.2) | 36 (72.0) | 16 (72.7) |
| Automated | 20 (27.8) | 14 (28.0) | 6 (27.3) |
| Time in PD (months) | 52.78 (SD 32.92) | 41.41 (SD 21.73) | 52.78 (SD 32.63) |
| Person who conducts dialysis | | | |
| Patient | 41 (58.6) | 31 (65.9) | 10 (43.5) |
| Caregiver | 22 (31.4) | 12 (25.5) | 10 (43.5) |
| Several | 7 (10) | 4 (8.5) | 3 (13.0) |
| Number of hospitalizations | 1.09 (SD 1.12) | 1.38 (SD 1.29) | 1.09 (SD 1.12) |
| Time since last hospitalization (months) | 12.0 (IQR 7.5-27.5) | 11.5 (IQR 6-24) | 12.0 (IQR 10-30) |
| Albumin (mg/dL) | 3.32 (SD 0.68) | 3.19 (SD 0.74) | 3.58 (SD 0.44) |
| Hematocrit (%) | 32.05 (SD 6.19) | 30.39 (SD 7.02) | 34.39 (SD 6.35) |
| BMI (kg/m ²) | 22.01 (SD 4.04) | 22.72 (SD 4.09) | 21.02 (SD 4.39) |
| Outcome | | | |
| Continued in PD | 46 (63.0) | 28 (56.0) | 18 (78.3) |
| Switched to hemodialysis | 16 (21.9) | 15 (30.0) | 1 (4.3) |
| Underwent transplant | 3 (4.1) | 1 (2.0) | 2 (8.7) |
| Deceased | 8 (10.9) | 6 (12.0) | 2 (8.7) |

IQR: inter quartile range; SD: standard deviation; MLW: minimum vital wage; PD: peritoneal dialysis.

tis was 0.60 episodes per patient per year and 0.05 episodes per patient per month (1 episode every 20 patient-months). Other characteristics of peritonitis episodes according to patient, infection, and treatment are presented in Table 2.

Culture data were obtained for 107 of the peritonitis episodes, 50 of which (46.7%) were positive cultures. *Staphylococcus aureus* was reported in 14 (28%) episodes, coagulase-negative *Staphylococcus* in 12 (24%) cultures and *Candida* sp. in 8 (16%) cultures. No polymicrobial cultures were reported, the antibiotic resistance in isolated germs are presented in the supplementary material (Annex 1).

DISCUSSION

The obtained incidence rate of peritonitis (0.60 episodes per patient-year) exceeds the ISPD recommendation of less than 0.50 episodes per patient-year⁽³⁾. This finding is similar to that reported in the same PD program for the pediatric population (0.61 episodes per patient-year)⁽⁸⁾, and is comparable to the incidence rates of peritonitis in other Latin American countries, which report between 0.35 and 0.80 episodes per patient-year⁽⁹⁻¹²⁾. Considerably low rates have been reported in the United States with 0.37 episodes per patient-year⁽¹³⁾, and in China with 0.17 episodes per patient-year⁽¹⁴⁾. This heterogeneity can be explained by the difference between countries in the percentage of RRT patients treated with PD, particularly in Mexico, the United States, and China where government policies favor PD.

In this study, the most frequent etiology for CKD was chronic glomerulonephritis (27.8%), a finding similar to that reported by studies conducted at a single PD center^(8,10,15), which differs from multiple studies that show that diabetic nephropathy is the main cause of CKD^(1,2). This could be explained by the small sample size, and the fact that only PD patients were analyzed.

A high rate of episodes with negative culture was found (53.3%), which could be related to the non-standardized method of processing peritoneal fluid samples or to the initiation of antibiotic therapy prior to sampling. This demonstrates the need to establish protocols for collecting and analyzing peritoneal fluid samples throughout the country. The same laboratory evaluated the peritoneal fluid samples, but not necessarily with the same machine, which can introduce measurement bias; however, it is likely that this bias is not different in natural settings.

Staphylococcus aureus was the most frequently isolated germ, which is consistent with a previous study conducted

Table 2. Characteristics according to peritonitis episodes in patients of the dialysis program of the Hospital Cayetano Heredia (2014-2016).

| Characteristics | n (%) |
|-------------------------------------|------------------------------------|
| Total episodes | 114 |
| 2014 | 33 (28.9) |
| 2015 | 37 (32.5) |
| 2016 | 44 (38.6) |
| Sex | |
| Women | 75 (65.8) |
| Men | 39 (34.2) |
| PD type | |
| Manual | 74 (65.5) |
| Automated | 39 (34.5) |
| Months in PD | 25.50 (IQR 17-38) |
| Fluid characteristics | |
| Initial leukocytes (cells/ μ L) | 1,100 Leu/ μ L (IQR 420-2,800) |
| Polymorphonuclears (%) | 70 (IQR 60-80) |
| Culture result | |
| Negative | 57 (53.3) |
| Positive | 50 (46.7) |
| Exit-site infection | |
| Yes | 6 (5.5) |
| No | 104 (94.5) |
| Peritonitis type | |
| Isolated | 107 (97.3) |
| Relapsing | 1 (0.9) |
| Recurrent | 0 (0.0) |
| Repeat | 3 (2.7) |
| Outcome | |
| Continued in PD | 92 (80.7) |
| Switched to hemodialysis | 15 (13.2) |
| Underwent renal transplant | 1 (0.9) |
| Deceased | 6 (5.3) |
| Treatment | |
| Ceftazidime | 94 (82.5) |
| Vancomycin | 96 (84.2) |
| Amikacin | 5 (4.4) |
| Ciprofloxacin | 2 (1.7) |
| Imipenem | 3 (2.6) |
| Meropenem | 3 (2.6) |
| Fluconazole | 2 (1.7) |

in Peru in 2007⁽¹⁶⁾. This microorganism has been associated with episodes of greater severity, increased risk of hospitalization, catheter removal, and even death⁽¹⁷⁾.

In addition, we found a relationship between lower hematocrit values and the occurrence of peritonitis. In the few

studies that have evaluated this variable, no statistically significant relationship has been found with the occurrence of peritonitis^(18,19).

Despite being a recognized risk factor⁽³⁾, the variable of previous or concomitant nasopharyngeal colonization was not considered as a variable because not all the patients had such a record.

No relationship was found between the dialysis method and the occurrence of peritonitis. Some studies suggest that the relative risk would be lower in the automated modality^(4,6); however, most studies report conflicting results.

In this study, no relationship was found between low income or low educational attainment and the occurrence of peritonitis, which differs from what was found in Australia⁽²⁰⁾, the United States⁽¹³⁾, and Taiwan⁽¹⁵⁾. It should be noted that two-thirds of the population observed in this study live in poverty, which may have influenced the outcome.

In the evaluated PD program, training sessions of no more than 2 hours per session are carried out for a period of 15 days, for a total of 30 hours. Likewise, retraining sessions are carried out every 6 months, or when the patient presented an episode of peritonitis. Evaluations are performed, in addition to follow-up visits after the placement of the peritoneal catheter, or for reported complications (peritonitis). Even though the results of the written assessment and home visits are recorded, these instruments have not been validated to assess the efficiency of the training, and therefore were

not included in the analysis.

Given the nature of the study, it is possible that there are intervening variables not considered in our analysis or not captured by the program. Another limitation could have been introduced by the exclusion of patients with incomplete analysis records, thus generating a selection bias. The small number of patients who did not develop peritonitis limited the possibility of an analytical design. It is suggested to carry out further studies of the longitudinal analytical type, with a larger population and a longer follow-up time to determine association and temporality between the mentioned factors and the occurrence of peritonitis in the study population.

In conclusion, the incidence rate of peritonitis and the amount of positive cultures found in the peritoneal dialysis program evaluated in a hospital in Lima, Peru, were found to be above internationally suggested limits. Lower hematocrit and lower serum albumin values were found to be related to the occurrence of peritonitis.

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