

Analysis of patients in peritoneal dialysis: clinical-epidemiologic factors and peritoneal transport type with hypertonic replacement

Análisis de pacientes en diálisis peritoneal: factores clínico-epidemiológicos y tipo de transporte peritoneal con recambio hipertónico

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Abstract

Introduction: Peritoneal dialysis has been an effective therapy in the management of patients with end-stage renal failure.

Objective: To determine the characteristics of the population and the type of peritoneal transport using hypertonic dialyzing solution.

Methods and Materials: Prospective and cross-sectional study in patients of the Nephrology Service of the Hospital Escuela Universitario of Tegucigalpa during the period from October 1 to November 15, 2016.

Results: Diabetic nephropathy was associated as the cause of chronic kidney disease in 18 (42.9%) patients, followed by nephropathy hypertensive disease with 14 (33.3%) and Mesoamerican nephropathy with 8 (19.0%). The most frequent type of peritoneal transport was the high average in 21 (50.0%) of the patients, followed by the low average with 12 (28.6%), low transport with 7 (16.7%) and high transport with 2 (4.8%).

Discussion: In Central America during the last years there has been an increase in the incidence of kidney disease in workers from the Pacific coast, especially male farmers with no risk factors, thus constituting the epidemic of Mesoamerican nephropathy. There is a relationship between the increase in solutes transfer and the decrease of the ultrafiltration with the passage of time.

Conclusions: Mesoamerican nephropathy is an emerging cause of disease in the region. No relationship was found between prolonged peritoneal dialysis time or the history of peritonitis with low peritoneal transport.

Key words: Kidney diseases, peritoneal dialysis, peritoneal balance test, peritoneal transport, peritoneum, Honduras.

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Resumen

Introducción: la diálisis peritoneal ha sido una terapia efectiva para los pacientes con falla renal terminal.

Objetivo: determinar las características de la población y el tipo de transporte peritoneal (utilizando una solución dializante hipertónica).

Materiales y métodos: estudio descriptivo transversal en pacientes del Servicio de Nefrología del Hospital Escuela Universitario de Tegucigalpa, durante el período comprendido entre el 1 de octubre al 15 de noviembre de 2016. **Resultados:** la nefropatía diabética fue identificada como la causa de nefropatía crónica en 18 (42.9 %) pacientes; seguida de la nefropatía hipertensiva, con 14 (33.3 %), y la nefropatía mesoamericana, con 8 (19.0 %). El tipo de transporte peritoneal más frecuente fue el promedio alto, en 21 (50.0 %) de los pacientes; seguido del promedio bajo, con 12 (28.6 %); el transporte bajo, con 7 (16.7 %); y el transporte alto, con 2 (4.8 %).



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Discusión: en Centroamérica, durante los últimos años, ha habido un aumento de incidencia de la enfermedad renal en trabajadores provenientes de la costa pacífica, especialmente varones agricultores sin factores de riesgo. Esto constituye una epidemia de la nefropatía mesoamericana. Existe una relación entre el aumento de la transferencia de solutos y la disminución de la ultrafiltración con el paso del tiempo.

Conclusiones: la nefropatía mesoamericana es una causa emergente de enfermedad en la región. No se encontró relación entre el tiempo prolongado de diálisis peritoneal, o el antecedente de peritonitis, y un transporte peritoneal bajo.

Palabras clave: enfermedad renal, diálisis peritoneal, prueba de equilibrio peritoneal, transporte peritoneal, peritoneo, Honduras.

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Introduction

Chronic kidney disease (CKD) represents a major health problem and its incidence has been increasing in recent years.¹ It is defined as the presence of a kidney lesion for a period longer than or equal to three months.

When there is a progression of the disease to a glomerular filtration rate lower than 15 mL/min/1.73m², renal replacement therapy is necessary.²⁻⁴ It can be done by hemodialysis, peritoneal dialysis or renal transplant (the latter is performed in Honduras since 1986)⁵. Focusing on peritoneal dialysis (PD), it has been an effective therapy in the management of patients with end-stage renal failure⁶ and it requires the integrity of the peritoneal membrane in order to adequately transport the waste products through it. Certain factors, such as episodes of peritonitis and prolonged exposure to the glucose of the dialyzing solution, have been associated with chronic peritoneal inflammation, which can decrease the effectiveness of the treatment.⁷

The objective of the study was to determine the characteristics of the population and the type of peritoneal transport (using a hypertonic dialyzing solution).

Materials and methods

A cross-sectional descriptive study was conducted in adult patients with end-stage CKD in the program of intermittent automated peritoneal dialysis of the Nephrology Service of the Hospital Escuela Universitario of Tegucigalpa, during the period between October 1 and November 15, 2016. The patients of the program had a single dialysis session of 24 continuous hours per week, through

the connection with a cyclor. The rest of the days, the patients of the program did not have any dialytic exchange.

The patients who met the inclusion criteria were studied, and the patients with active peritonitis or who suffered from peritonitis during the period of the last six months, with less than 30 days of starting treatment, those patients admitted to hospital wards due to other pathology; and those patients who did not accept to participate in the study were excluded. Prior to the study, authorization was requested to the Committee of Ethics and Biomedical Research of the Faculty of Medical Sciences (CEIB-FCM) and also to each patient before the application of the test through a written informed consent.

The clinical and epidemiological data of the study were obtained through an instrument of 35 questions (20 closed and 15 open) about the clinical history of the patients. To establish the type of peritoneal transport, samples were taken according to the method of Twardowski *et al.*, using dialyzing solution at 4.5%, after the dialysis cycle. The ultrafiltration test was not performed because it was not the objective of the study.

With the values of creatinine obtained from the sample of peritoneal fluid, we proceeded to correct the result (in relation to the interference that the Jaffe reaction presents in the presence of high glucose values). For this, the correction factor of the University of Missouri, of 0.000531415 was applied.

Data processing was carried out based on the tables and frequencies of the quantitative and qualitative variables of the results. The statistical analysis was performed using the Epi-Info software

package (version 7.2) and was complemented with the elaboration of texts, tables and graphs in the Microsoft Office Word, Microsoft Office Excel and Microsoft Office Power Point packages.

Results

The population universe corresponded to 105 patients. After applying the inclusion and exclusion criteria, a total of 42 patients on dialysis were included. Of them, 21 (50.0 %) patients corresponded to the female gender and 21 (50.0 %) to the male gender. The average age of the patients was 55.1 ± 13.6 years. Of them, 7 (16.7 %) patients were between 18 and 44 years old, 24 (57.1 %) were between 45 and 64 years of age and 11 (26.2 %) patients were older than 64 years.

The relationship between the age groups and the gender showed that 61.9 % of the patients in the middle-aged adult group were women. Among the main comorbidities of the population it was found arterial hypertension in 39 (92.9 %) patients, followed by diabetes mellitus, in 20 (47.6 %); and hypothyroidism, in 3 (7.1 %) cases ([Figure 1](#)).

Diabetic nephropathy was identified as the cause of CKD in 18 (42.9%) patients, followed by hypertensive nephropathy, with 14 (33.3%); and Mesoamerican nephropathy, with 8 (19.0%) cases. ([Figure 2](#))

In relation with the place of origin, the majority of patients came from the Department of Francisco Morazán, with 19 cases (45.2 %); followed by El Paraíso, with 12 (28.6%); Comayagua, with 5 (11.9 %); La Paz, with 2 (4.8 %); Choluteca, with 1 (2.4 %); Olancho, with 1 (2.4 %); Gracias a Dios, with 1 (2.4 %); and Valle, with 1 (2.4 %). These departments correspond to the Central, Southern and Eastern regions of the country. The municipality with the highest provenance of patients was the Central District, with 13 (31.0%) patients. ([Figure 3](#))

The average time of permanence in peritoneal dialysis at the time of the study was 1.7 years. Of the studied patients, 13 (31.0 %) stated that they performed some type of physical activity. In relation to the frequency of change of the peritoneal dialysis catheter, 11 (26.2 %) patients had 1 replacement; 3 (7.1 %), 2 replacements; 2 (4.8 %), 3 replacements;

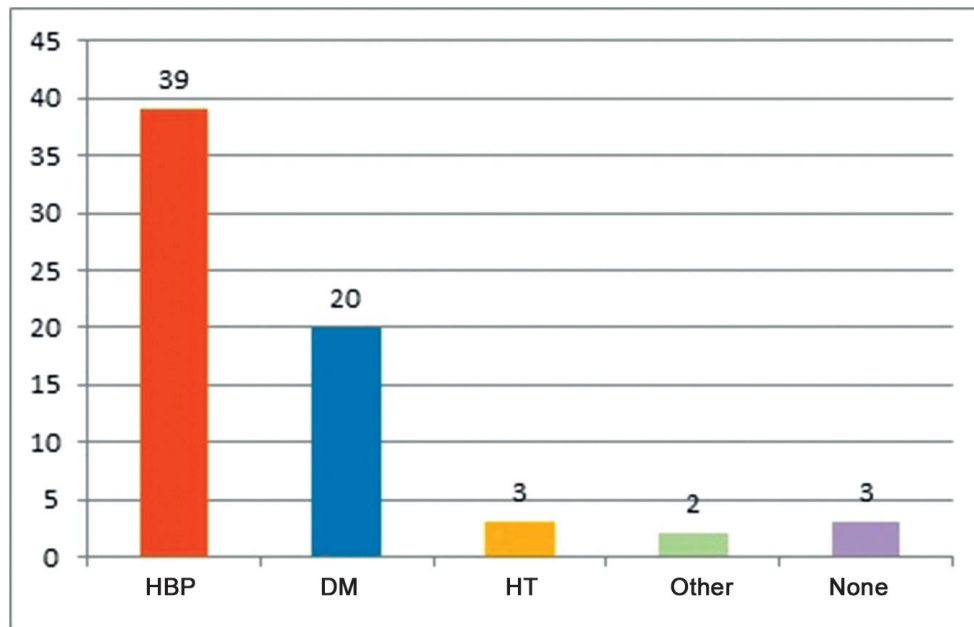


Figure 1. Comorbidities of the patients in peritoneal dialysis. HBP: high blood pressure; DM: diabetes mellitus; HT: hypothyroidism.

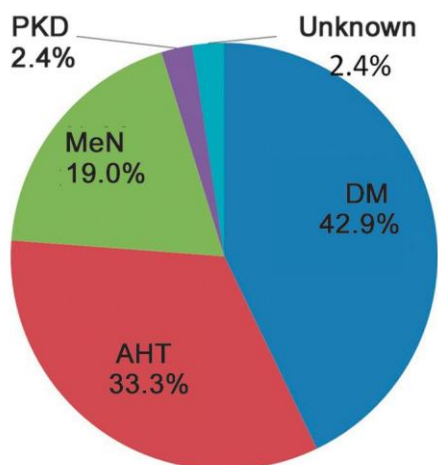


Figure 2. Causes of chronic kidney disease. DM: diabetic nephropathy; AHT: hypertensive nephropathy; MeN: Mesoamerican nephropathy; PKD: polycystic kidney disease.

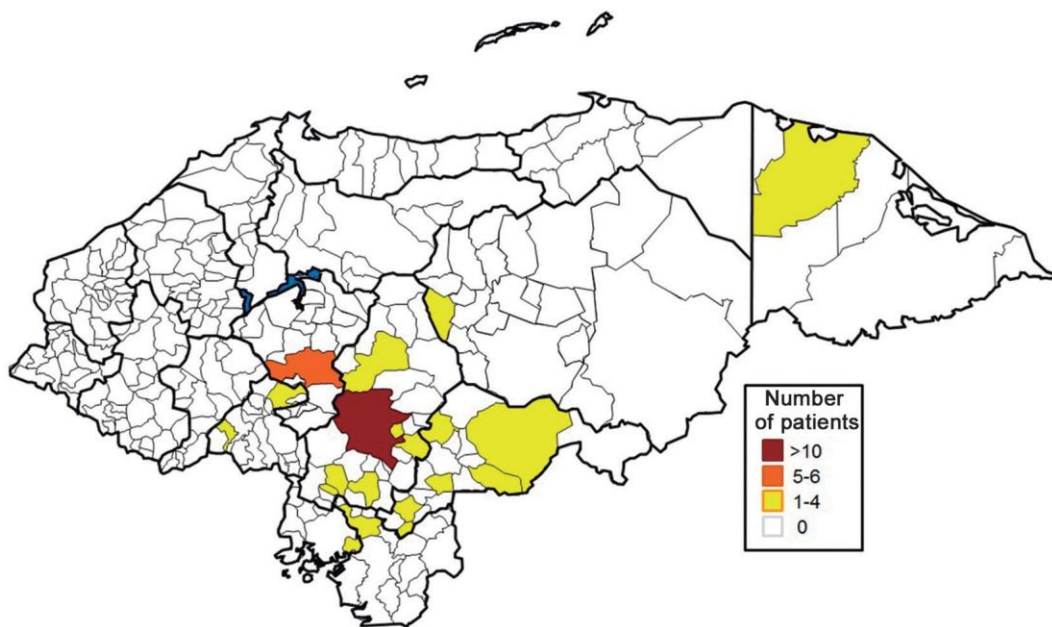


Figure 3. Municipalities of origin of the patients.

1 (2.4 %), 4 replacements; and 1 (2.4%), 7 catheter replacements; and 24 (57.1 %) did not have any replacement of the catheter. It should be mentioned that these replacements were mainly due to catheter-associated infections.

The most frequent type of peritoneal transport was the high-average (0.65-0.81), in 21 (50.0%) of the patients; followed by the low-average (0.5-

0.64), in 12 (28.6%); low transport (<0.5), in 7 (16.7%; and high transport (>0.81), in 2 (4.8%) ([Table 1](#)).

We found 9 (21.4 %) patients with less than 6 months on peritoneal dialysis; 14 (33.3 %) between 6 and 12 months; 10 (23.8 %) between 13 and 24 months; 6 (14.3 %) between 25 months and 5 years; and 3 (7.1 %) with 5 years or more ([Table 2](#)).

Table 1. Type of peritoneal transport.

Type of Transport	Gender		N	%
	F	M		
High	1	1	2	4.8
High-average	9	12	21	50.0
Low-average	6	6	12	28.6
Low	5	2	7	16.7

Table 2. Peritoneal transport in relation with the time on dialysis.

	Type of transporter	Time on dialysis
	« < » 1 year	> 1 year
High	1	1
High-average	9	12
Low-average	7	5
Low	6	1

Regarding the time on peritoneal dialysis of the patients and the type of transport, 23 patients were found with one year or less of dialytic therapy, 10 (43.5 %) of whom were high or high-average transporters. On the other hand, in the group of patients with more than one year of treatment, 19 patients were found, of whom 13 (68.4 %) were high or high-average transporters.

The antecedent of peritonitis was found in 6 (14.3%) patients. Of them, 4 (66.7 %) corresponded to male patients and 2 (33.3 %) to women. According to the antecedents found, there was an average of 0.1 episodes per patient per year. Of the 6 patients with antecedent of peritoneal infection, 5 (83.3 %) were high or high average transporters at the time of the study; while 1 (16.7 %) patient was classified within the categories of low average or low transporter.

Discussion

Worldwide, between 10 % and 15 % of the cases use PD as replacement therapy. In Mexico, PD is used in the majority of cases as treatment for end-

stage nephropathy.⁴ Instead, in the United States, hemodialysis is used in the majority of patients.⁸

In Honduras, according to data of the Ministry of Health, there are about 3500 patients with end-stage CKD, who, in their majority, receive hemodialysis. The majority of the population included in the study came from the Departments of Francisco Morazán and El Paraíso, similarly to what was reported by Durón *et al.* in the year 2000.

Peritoneal dialysis has been performed through several modalities, with continuous or intermittent technique, either manually or with a cyclor. Continuous ambulatory PD (CAPD) consists in the realization of certain number of daily exchanges by the patient, usually between 3 and 5 with long permanences.⁹ Instead, the automated PD (APD), uses a cyclor for about 8 hours with several exchanges of equal duration, sometimes with a dry day (in which the peritoneal cavity of the patient remains empty during the day, so that the process is commonly performed during the night).^{8,10} In this study, all patients are in intermittent automated peritoneal dialysis, which consists in the connection

of the patients to a cyclor machine during 24 hours every 7 days. The remaining days are dry.

It is recommended to individualize the treatment for each patient on PD, which is possible through the PEP⁴ and the measurement of the intraperitoneal hydrostatic pressure.¹¹ The PEP allows a formal evaluation of the characteristics of the peritoneal membrane, which reflects the rates of transfer of creatinine and glucose through the indices obtained in serial measurements.⁸

In this study, the high-average transport was found as the most common in the studied patients (50.0 % of the cases), followed by the low-average (28.6 %), the low transport (16.7 %) and the high transport (4.8 %). This frequency is consistent with that quoted by Keshaviah, who presents the high-average transport in 53 % of the cases and the low-average in 31 %; but presents an inversion regarding the high (with 10 %) and low transport with (6 %).¹²

In relation to the original values found by Twardowski et al., in 1987, it was found a mean value at hour 0 which was 3.4-fold higher. Subsequently, similar values were found at hours 2 and 4.^{13,14,15} (Table 3).

The PEP allows us to know in what type of dialysis modality the patient should be. According to it, automated peritoneal dialysis (APD) is indicated for high transporters;¹² the continuous cyclic (CCPD), for high-average, and the continuous ambulatory (CAPD), for low-average. In the low transporters, APD or hemodialysis may be required^{4,16} (for this, the status and the associated pathologies that each patient presents should also

be taken into account).^{17,18} A study conducted in La Coruña, Spain, in 2012 applied the PEP to determine the loss of peritoneal proteins. It found that the CAPD was associated to a greater protein loss in the peritoneal fluid than the DPA.¹⁹

In the United States, the main cause of renal failure is diabetic nephropathy and the second cause is hypertensive nephropathy. Other causative disorders include glomerulonephritis, renal polycystosis and obstructive uropathy.⁸ Meanwhile, in Central America and Mexico, it has been observed in the last years an increased incidence of kidney disease in workers coming from the Pacific coast (especially male farmers without risk factors, which constitutes the epidemic of Mesoamerican nephropathy).²⁰ In this study, the main cause of CKD was diabetes mellitus (with 42.9 % of cases); while the other causes were, in descending order, arterial hypertension, Mesoamerican disease, polycystic nephropathy and nephropathy of undetermined cause.

Renal patients die, mainly, from cardiovascular diseases and infections. The elimination of solutes increases with physical activity, which perhaps depends on a more efficient flow dynamics within the abdominal cavity.⁸ It was found that 31.0% of the patients in this study carried out some contributing physical activity, such as activities at home, recreational activities and moderate exercise.

Peritonitis is the main complication associated with PD. Its incidence has decreased overtime, due to improvements in the systems of connection, control and treatment of the carriers of *Staphylococcus aureus*. Likewise, it has decreased with the education of the patients.²¹

Table 3. Comparative table of results.

Variable	Twardowski	HEU
Patients	86	42
D/P 0 hours	0.07±0.05	0.24±0.10
D/P 2 hours	0.48±0.14	0.48±0.11
D/P 4 hours	0.65±0.16	0.65±0.14

There is a relationship between the increase in solutes transfer (creatinine D/P) and the decrease in ultrafiltration with the passage of time. This process is accentuated by episodes of peritonitis and it has been associated with an increase in mortality and a higher risk of failure of the technique in the patients.²² However, an association between the time elapsed in dialysis and the peritoneal transport was not found in this study.

The biggest problem of the patients in PD, today, is still the loss of the useful peritoneal cavity: a single episode of peritonitis can cause morphological and functional changes in the peritoneal membrane. In this study, the antecedent of peritonitis was found in 6 (14.3 %) patients. In the year 2000, Durón *et al.* found the antecedent of secondary peritonitis in 74.7 % of the patients.^{23,24} An association between the episodes of peritonitis and the peritoneal transport was not found either in this study. International studies have mentioned a higher incidence of peritonitis in males (with 66.66 %; and 62.5 %, in relation to women), data that are similar to other studies.²²

The technical survival in PD remains lower than in hemodialysis. To explain this, several mechanisms have been proposed, among which the episodes of peritonitis, different comorbidities, the presence of systemic diseases and the failure in ultrafiltration stand out as some of the most important causes or treatment abandonment.^{17,25,26}

Conclusions

The places of greatest provenance of patients in peritoneal dialysis studied were the Departments of Francisco Morazán and El Paraíso, corresponding to the Central-Southern and Eastern regions of Honduras, which in the last years have seen the emergence of the Mesoamerican nephropathy.

Mesoamerican nephropathy represents an important cause of kidney disease in the Central American region, being found in this study as the third leading cause of CKD, after diabetes mellitus and arterial hypertension.

No relationship was found between the prolonged period of peritoneal dialysis or the history of peritonitis, with a low peritoneal transport. In addition, a similarity of results was found with respect to those described by Twardowski in his original study. However, the values could have been influenced by the variation of the hypertonic replacement used in this study.

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Ethical responsibilities

Protection of people and animals

The authors declare that no experiments were performed on human beings or animals for this research.

Data confidentiality

The authors declare that they have followed the protocols of their workplace on the publication of patient data.

Right to privacy and informed consent

The authors declare that patient data do not appear in this article

Conflict of interest

The authors declare they do not have any conflict of interest.

Contribution of the authors

Fernando Arturo Fajardo Leitzelar, Manuel Sierra, Daniel Martín Barahona López, Luis Enrique

Sánchez Sierra, Carlos Felipe Matute Martínez, Daniel Eduardo Mendoza Sabillón, Andrea Carolina Núñez Hernández, Osiris Mariel Serrano Puerto have contributed to the ideation and design of the study, data collection and analysis, as well as in the discussion and writing of the final report of the study.

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