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# Patient and technique survival in continuous ambulatory peritoneal dialysis in a single center of the west of Mexico

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**ABSTRACT**

**Introduction.** In Mexico, CAPD survival has been analyzed in few studies from the center of the country. However, there are concerns that such results may not represent what occurs in other province centers of our country, particularly in our geographical area. **Aim.** To evaluate the patient and technique survival on CAPD of a single center of the west of Mexico, and compare them with other reported series. **Design**. Retrospective cohort study. **Setting**. Tertiary care, teaching hospital located in Guadalajara, Jalisco. **Patients**. Patients from our CAPD program (1999-2002) were retrospectively studied. **Interventions**. Clinical and biochemical variables at the start of dialysis and at the end of the follow-up were recorded and considered in the analysis of risk factors. **Main outcome measures**. Endpoints were patient (alive, dead or lost to follow-up) and technique status at the end of the study (June 2002). **Results**. 49 patients were included. Mean patient survival (± SE) was 3.32 ± 0.22 years (CI 95%: 2.9-3.8 years). Patients in the present study were younger (39 ± 17yrs), had larger body surface area (1.72 ± 0.22 $m^2$), lower hematocrit (25.4 ± 5.2%), albumin (2.6 ± 0.6g/dL), and cholesterol (173 ± 44 mg/dL), and higher urea (300 ± 93mg/dL) and creatinine (14.9 ± 5.6 mg/dL) than those in other Mexican series. In univariate analysis, the following variables were associated ($p < 0.05$) to mortality: pre-dialysis age and creatinine clearance, and serum albumin and cholesterol at the end of follow-up. In multivariate analysis, only pre-dialysis creatinine clearance (RR 0.66, $p = 0.03$) and age (RR 1.08, $p = 0.005$) significantly predicted mortality. Mean technique survival was 2.83 ± 0.24 years (CI 95%: 2.4-3.3). Pre-dialysis age ($p < 0.05$), peritonitis rate ($p < 0.05$), and serum phosphorus at the end of follow-up **($p < 0.05$)** were associated with technique failure in univariate analysis, while in multivariate analysis, only pre-dialysis age (RR 1.07, $p = 0.001$) and peritonitis rate (RR 481, $p < 0.0001$) were technique failure predictors. **Conclusions**. Patients from this single

***Sobrevida del paciente en la técnica de diálisis peritoneal continua ambulatoria en un centro del occidente de México***

***RESUMEN***

***Introducción.*** *En México, la sobrevida en DPCA ha sido analizada en algunos estudios realizados en el centro del país. Sin embargo, hay evidencias que sugieren que dichos resultados podrían no representar lo que ocurre en otros hospitales de distintas ciudades del país, particularmente en el área geográfica del occidente del país.* ***Objetivo.*** *Evaluar la sobrevida del paciente y de la técnica de DPCA en un hospital del occidente de México.* ***Diseño.*** *Cohorte retrospectiva.* ***Centro.*** *Hospital-Escuela de tercer nivel de atención localizado en Guadalajara, Jalisco.* ***Pacientes y Métodos.*** *Todos los pacientes del programa de DPCA (1999-2002), fueron estudiados de manera retrospectiva.* ***Variables de respuesta.*** *Status del paciente (vivo, muerto o perdido al final del seguimiento), y de la técnica hasta el mes de Junio de 2002.* ***Resultados****. Se incluyeron 49 pacientes. La sobrevida promedio (± EE) fue 3.32 ± 0.22 años (IC 95%: 2.9 – 3.8 años). Los pacientes de este estudio fueron más jóvenes (39 ± 17 años), tuvieron mayor superficie corporal (1.72 ± 0.22 $m^2$), menor hematocrito (25.4 ± 5.2%), albúmina (2.6 ± 0.6 g/dL), y colesterol (173 ± 44 mg/dL) así como mayor urea (300 ± 93mg/dL) y creatinina (14.9 ± 5.6 mg/dL) que aquellos pacientes de otras series mexicanas. En el análisis univariado, las variables que se asociaron significativamente con la mortalidad de los pacientes ($p < 0.05$) fueron: edad y depuración de creatinina al inicio de la diálisis, así como albúmina sérica y colesterol sérico al final del seguimiento. En el análisis multivariado sólo la depuración de creatinina al inicio de la diálisis (RR 0.66, $p = 0.03$) y la edad de inicio (RR 1.08, $p = 0.005$) predijeron de manera significativa la mortalidad. La sobrevida de la técnica promedio fue 2.83 ± 0.24*

center of the west of Mexico were younger, had higher body surface area and initiated peritoneal dialysis with a more deteriorated general status than patients reported in other Mexican series; in spite of the latter, patient and technique survival were not different. In our setting, pre-dialysis older age and lower CrCl significantly predicted mortality, while older predialysis age and higher peritonitis rate predicted technique failure.

**Key words.** CAPD survival. Age. Pre-dialysis creatinine clearance. Peritonitis rate. Mexican patients**.**

*años (IC 95%: 2.4-3.3). La edad al inicio de la diálisis (p < 0.05), la tasa de peritonitis (p < 0.05) y el fósforo sérico al final del estudio* ***(p < 0.05)*** *se asociaron con la falla de la técnica en el análisis univariado, mientras que en el análisis multivariado sólo la edad al inicio de la diálisis (RR 1.07, p = 0.001) y la tasa de peritonitis (RR 481, p < 0.0001) predijeron significativamente la falla de la técnica.* ***Conclusiones.*** *Los pacientes de este centro del occidente del país fueron más jóvenes, tuvieron mayor superficie corporal e iniciaron diálisis peritoneal con mayor deterioro de su estado general, que los pacientes que se han informado en otras series de diálisis peritoneal en México; sin embargo la sobrevida del paciente y de la técnica no fueron diferentes. En nuestro medio la mayor edad y la menor depuración de creatinina al inicio de la diálisis, predijeron significativamente la mortalidad, mientras que la mayor edad y el mayor índice de peritonitis predijeron la falla de la técnica.*

***Palabras clave.*** *Sobrevida en DPCA. Edad. Depuración de creatinina prediálisis. Indice de peritonitis. Pacientes mexicanos.*

## INTRODUCTION

Peritoneal dialysis is the most frequently employed renal replacement therapy in Mexico.[1] Several factors has been described as cause of poor patient survival in peritoneal dialysis: older age, high peritoneal transport rate, diabetes mellitus (DM), cardiovascular disease, malnutrition, inflammation, low residual renal function, anemia, and other comorbidities.[1-8] More recently, the effect of dialysis dose in continuous ambulatory peritoneal dialysis (CAPD) patient survival has been questioned.[9] On the other hand, technique failure in peritoneal dialysis is associated to infection (peritonitis and catheter related), dialysis modality, DM, hypoalbuminemia, age (with contradictory results), and in some cases with the number of patients in the dialysis unit.[2,6,8,10,11]

In Mexico, CAPD survival has been analyzed in a few studies with most of patients recruited from the center of the country.[8,9] Patient survival has been estimated to be similar, although technique survival seems to be lower than in other developed countries.[8] However, there are some concerns that such results may not represent what occurs in other province centers of our country, particularly in our geographical area. Although the ADEMEX study had a multicenter design, a sub-analysis showing regional data was not provided. Therefore, the aims of this study were to evaluate the patient and technique survival on CAPD of a single center of the west of Mexico, and compare them with other reported series.

## PATIENTS AND METHODS

This is a retrospective cohort study, including consecutive patients on CAPD from the period between January 1999 to June 2002. Patients were in the CAPD program of a tertiary care teaching hospital (UMAE Hospital de Especialidades, CMNO, IMSS) and were included if they had available clinical and biochemical records. In some cases there was neither the minimal information nor even clinical charts, and these patients were excluded from the cohort. All patients used a double-bag system (Beny™, *Laboratorios Pisa SA de CV*). Erythropoietin was used intermittently (depending on availability) in these patients.

Clinical and serum biochemical variables within 1 week prior to CAPD onset were collected from the medical records. Clinical variables included: age, sex, cause of end-stage renal disease (ESRD), blood pressure and body mass index (BMI). Serum/blood biochemical variables were: glucose, creatinine, urea, albumin, hemoglobin, total leukocyte count, cholesterol, triglycerides, calcium, phosphorus, sodium, and potassium. Creatinine clearance (CrCl) was estimated using the Cockcroft and Gault formula adjusted to 1.73 $m^2$ surface area. All the above variables were also recorded at the end of the follow-up [20.2 ± 12.0 (range 4-49) months].

At the end of the study, patient status (alive, dead or lost to follow-up), and technique failure were registered. Patient was considered as lost to

follow-up when he/she failed to the last two clinical appointments, or when there was not information in the clinical chart within the last 6 months. When possible, cause of death was registered. Technique failure was defined as change to hemodialysis, failure of ultrafiltration or solute removal, intolerance to dialysis volume, and death with functioning dialysis.

### Statistical Analysis

Data are shown as mean ± SD, median (percentiles 25-75%), or percentages. When analyzing patient survival, patients alive at the end of the study, transferred to hemodialysis or with renal transplantation were considered as censored data. Patients who died within the first 3 months after transferring to hemodialysis or receiving a kidney graft were considered as death related to CAPD. For technique survival analysis, only transferring to hemodialysis and death were considered as events; a functioning dialysis at the end of the study, or renal transplantation were considered as censored data. Analysis for both patient and technique survival was done using the Kaplan-Meier method, and comparison by factors was performed by the Log-rank test. Mortality and technique failure risks were analyzed by a multivariate Cox's proportional-hazard model in which all the significant variables from the univariate analysis were included (in a backward manner), and/or those variables considered clinically relevant according to the current literature. To compare our results with those from other Mexican studies, an analysis of variance was initially calculated from the published data of such series with the intention of determining variance distribution of the variables. Once the latter was known, a Student $t$ or $\chi^2$ tests were employed to compare their data with ours. A $p$ value $< 0.05$ was accepted as significant.

## RESULTS

In contrast to other IMSS regional hospitals running huge PD programs, our tertiary healthcare hospital had a smaller one. Sixty-five patients comprised the whole population in our center during the studied period of time. From these patients, only 49 were included; the remaining 16 patients were not included as they had no clinical or biochemical records available. Only one patient received hemodialysis before peritoneal dialysis. Two patients were on automated peritoneal dialysis, but they were on CAPD 4 months previously. Table 1 shows the baseline clinical characteristics. The majority of patients were male. As it is common in our country, the most frequent causes of ESRD were diabetes mellitus type 2 and unknown cause. Median peritonitis rate was 1.03 (0-2.0) event/patient/year; 16 (33%) had no peritonitis, while 10 (20%) had 1 peritonitis episode, and 23 (47%) had 2 or more peritonitis events (2 patients had 7 events). Nine patients were 10.3 ± 3.8 months on conventional "standard spike" connection system before to change to a double-bag system; their peritonitis rate was not significantly different [0.73 (0.2-1.0) event/patient/year] from those that were on double-bag system since the beginning of dialysis. Mean number of installed catheters were 1.71 ± 0.87. Only 25 (51%) catheters functioned correctly since the first installation; in the rest, it was necessary a reinstallation at least in 1 more occasion (range 2-4). Twelve catheters were lost in association with peritonitis, and 14 were associated with dysfunction.

Pre-dialysis and final results are shown in Table 2. Mean follow-up was 20.2 ± 12.0 months (range 4 -49). There was a significant decrease in diastolic blood pressure, and serum urea, creatinine, phosphorus and potassium levels at the end of the follow-up, while calcium values significantly increased. No other variable displayed a significant change.

### Patient and technique survival

From the 49 subjects included, there were not losses to follow-up. Eighteen (37%) patients were

Table 1. Baseline clinical characteristics.

| Variable | Value |
|---|---|
| N | 49 |
| Sex n (%) | |
| male: female | 30 (61) : 19 (39) |
| Age (years) | 39.1 ± 16.8 |
| Etiology of ESRD: | |
| Diabetes Mellitus type 2 | 17 (35%) |
| Unknown | 16 (33%) |
| Lupus nephritis | 4 (8%) |
| Nephrosclerosis | 4 (8%) |
| Chronic glomerulonephritis | 4 (8%) |
| Other | 4 (8%) |

Table 2. Comparisons of clinical and biochemical variables pre-dialysis and at the end of follow-up.

| Variable | Pre-dialysis | End of follow-up | p value |
|---|---|---|---|
| Weight (kg) | 65.6 ± 14.8 | 63.8 ± 13.9 | 0.70 |
| BMI (kg/m$^2$) | 23.9 ± 4.3 | 23.2 ± 4.1 | 0.08 |
| Systolic blood pressure (mm Hg) | 151 ± 20 | 147 ± 15 | 0.15 |
| Diastolic blood pressure (mm Hg) | 94 ± 11 | 89 ± 9 | < 0.0001 |
| Glucose (mg/dL) | 128 ± 67 | 121 ± 64 | 0.55 |
| Cholesterol (mg/dL) | 173 ± 44 | 164 ± 44 | 0 29 |
| Hemoglobin (g/dL) | 8.3 ± 1.6 | 8.4 ± 1.7 | 0.55 |
| Leukocytes (mm$^3$) | 7646 ± 3126 | 7707 ± 2967 | 0.64 |
| Urea (mg/dL) | 300 ± 93 | 148 ± 50 | < 0.0001 |
| Creatinine (mg/dL) | 14.9 ± 5.6 | 10.7 ± 3.8 | < 0.0001 |
| Albumin (g/dL) | 2.6 ± 0.6 | 2.6 ± 0.5 | 0.40 |
| Calcium (mg/dL) | 7.9 ± 1.3 | 8.7 ± 0.9 | 0.001 |
| Phosphorus (mg/dL) | 6.0 ±1.8 | 5.0 ± 1.7 | < 0.0001 |
| Sodium (mg/dL) | 137 ± 4 | 137 ± 5 | 0 21 |
| Potassium (mg/dL) | 5.1 ± 0.7 | 4.5 ± 0.8 | < 0.0001 |

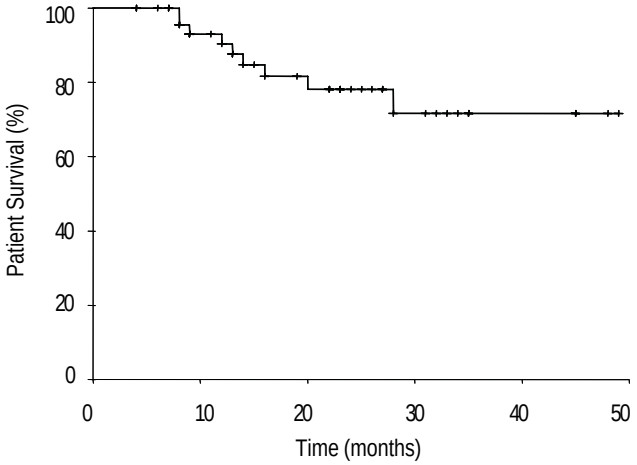


*Figure 1. Patient survival analysis (Kaplan-Meier method).*

alive on CAPD at the end of follow-up, 9 (18%) were dead, 7 (14%) were transferred to hemodialysis, 15 (31%) received a renal transplant and no patient recovered renal function after entering to the study.

Median patient survival (Figure 1) was 20 (11–28) months. Survival at 1, 2 and 3 years was 90%, 78%, and 72%, respectively. In the univariate analysis, the factors (considered as numeric variables) that significantly predicted mortality were pre-dialysis age (RR 1.08, p = 0.001), pre-dialysis creatinine clearance (RR 0.72, $p = 0.06$), as well as serum albumin (RR 0.20, p = 0.05) and cholesterol (RR 0.98, $p = 0.02$) at the end of the follow-up. In the multivariate analysis, however, only pre-dialysis age and pre-dialysis creatinine

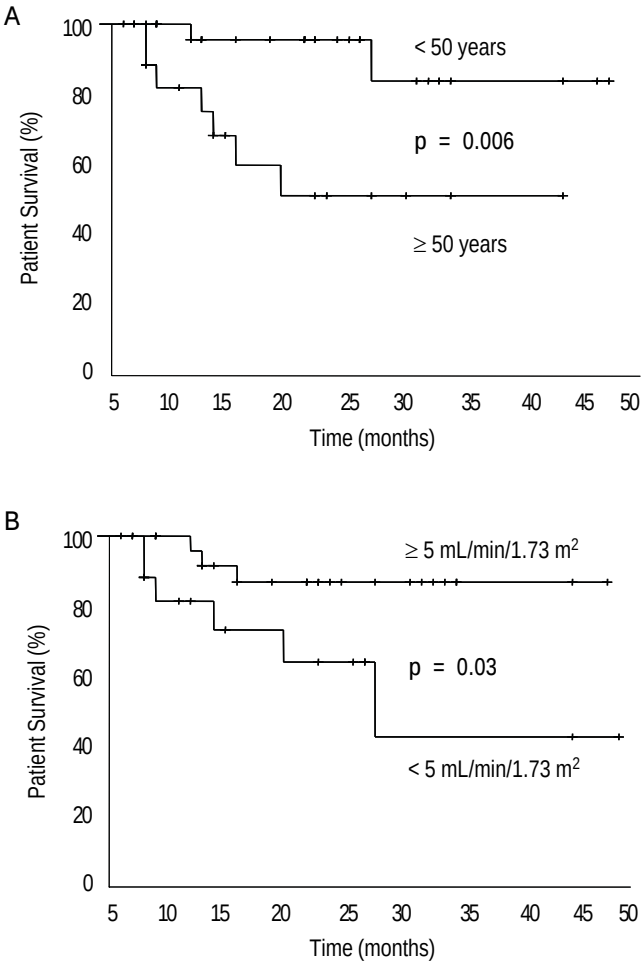


*Figure 2. Patient survival according to: A. Patient age. B. Creatinine clearance. The cut-off points of the latter variables in this figure were selected considering previous information.[8,9]*

Table 3. Results of the multivariate analysis ($\chi^2$ = 13.5, p = 0.001) predicting mortality of patients.

| Variable | β | RR (CI 95%) | p value |
|---|---|---|---|
| Pre-dialysis age | 0.06 | 1.07 (1.00-1.13) | 0.04 |
| Pre-dialysis creatinine clearance | –0.54 | 0.59 (0.36–0.94) | 0.03 |
| Final serum cholesterol | –0.01 | 0.99 (0.97–1.01) | 0 21 |
| Final serum albumin | –0.12 | 0.89 (0.12–6.38) | 0 90 |

Table 4. Results of the multivariate analysis ($\chi^2$ = 19.3, p < 0.001) predicting technique failure.

| Variable | β | RR (CI 95%) | p value |
|---|---|---|---|
| Peritonitis rate | 1.82 | 6.16 (1.66–22.90) | 0.007 |
| Pre-dialysis age | 0.07 | 1.06 (1.02–1.11) | 0.004 |
| Pre-dialysis diastolic BP | 0.01 | 1.01 (0.95–1.07) | 0.74 |
| Final serum phosphorus | –0.27 | 0.77 (0.53–1.10) | 0.15 |

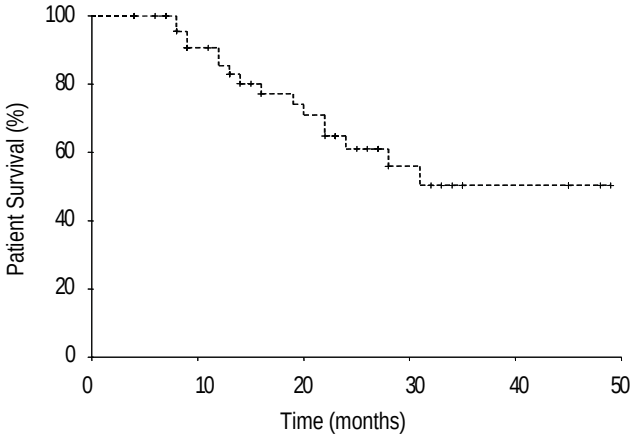


*Figure 3. Technique survival analysis (Kaplan-Meier method).*

clearance significantly predicted mortality (Figure 2 and Table 3).

Technique failure was observed in 16 (32%) patients at the end of the follow-up. Causes for this technique loss were death in 9 patients (56%), and transfer to hemodialysis due to membrane failure in 7 (44%). Median technique survival (Figure 3) was 19 months (13–26 Inter-quartile range). Technique survival at 1, 2 and 3 years was 90%, 61%, y 50%, respectively. In the univariate analysis, factors significantly predicting technique failure were peritonitis rate (RR 1.63, $p$ = 0.001), pre-dialysis age (RR 1.06, $p$ = 0.002), serum phosphorus (RR 0.73, $p$ = 0.04) at the end of follow-up and pre-dialysis diastolic blood pressure displayed a non-significant trend as predictors in this analysis (RR 1.06, $p$ = 0.06). However, in the multivariate analysis, only peritonitis rate and pre-dialysis age significantly predicted technique failure (Figure 4 and Table 4).

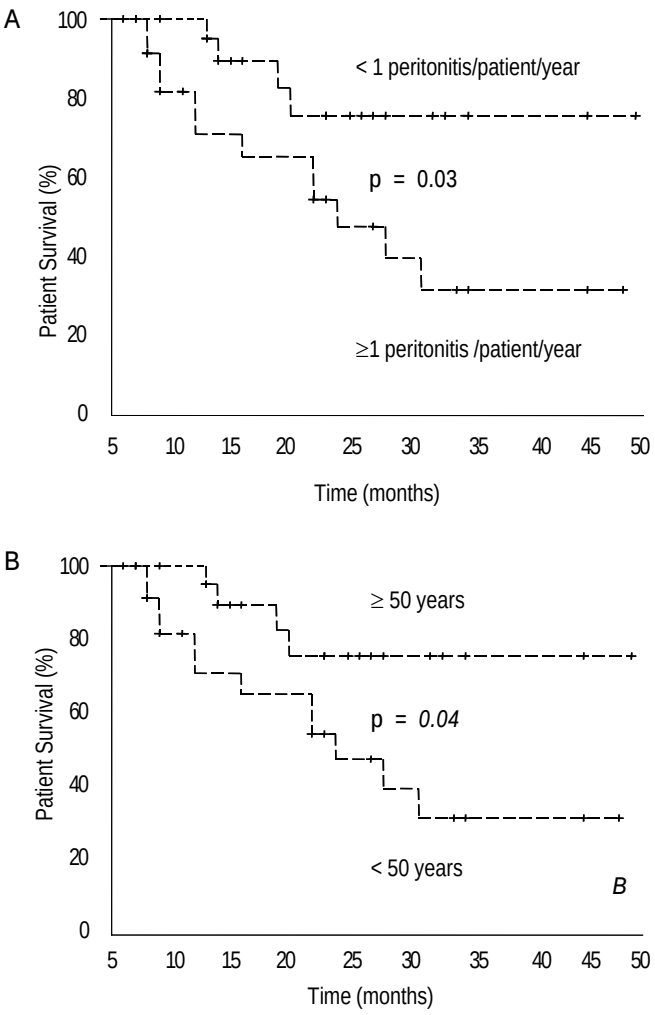


*Figure 4. Technique survival according to: A. Peritonitis rate. B. Patient age. The cut-off points of the latter variables in this figure were selected considering previous information.[8,9]*

### Comparison with other Mexican series

A further analysis comparing the cohort of the present study with those of other reported Mexican series [the Instituto Nacional de la Nutrición Salvador Zubirán (INNSZ) cohort[8] and the control group of the ADEMEX study[9]] was performed (Table 5). Patients in the present study were younger, taller, had lower baseline hematocrit, serum albumin and cholesterol, and higher urea and creatinine than those in the other series. Patients in the ADEMEX study had a lower baseline renal CrCl; in all cases, however, CrCl seemed to be lower than the recommended at initiation of dialysis. The rest of the variables analyzed were not different between cohorts. In addition, patient and technique survival were not significantly different between the cohort of the present study and those from the INNSZ or the ADEMEX study (Table 6).

## DISCUSSION

This study was performed to evaluate the patient and technique survival on CAPD in one tertiary care hospital of the west of Mexico. As it is usual in our country, patients in this study were young, and had a high proportion of diabetes mellitus and unknown cause of ESRD[8,9,12]. Peritonitis rate was similar to that reported in other overseas[13,14] and Mexican series.[8,9]

**Table 5.** Comparisons of baseline clinical and biochemical variables between 3 Mexican CAPD cohorts†.

| Variable | Hospital de Especialidades | INNSZ[8] | ADEMEX[9] |
|---|---|---|---|
| Age (years) | 39.1 ± 16.8*¶ | 45.2 ± 18.2 | 47.9 ± 14.10* |
| Female : Male (%) | 39 : 61 | 51 : 49 | 40 : 60 |
| Diabetes mellitus (%) | 35 | 37 | 44 |
| Peritonitis (/patient/year) | 1.4 ± 1.6 | 1.0 ± 2.8 | 2.0‡ |
| Weight (kg) | 65.6 ± 14.8 | 62.5 ± 13.6 | 65.4 ± 12.4 |
| Height (m) | 1.65 ± 0.09*¶ | 1.60 ± 0.09 | 1.61 ± 0.09 |
| Body surface area ($m^2$) | 1.72 ± 0.22* | 1.64 ± 0.19 | 1.68 ± 0.18 |
| Renal CrCl (mL/min/1.73 $m^2$) | 6.7 ± 2.5¶ | 7.3 ± 3.8 | 1.7 ± 2.5* |
| Systolic blood pressure (mm Hg) | 151 ± 20 | - | 153 ± 27 |
| Diastolic blood pressure (mm Hg) | 94 ± 11 | - | 90 ± 14 |
| Hematocrit (%) | 25.4 ± 5.2¶ | 26.7 ± 5.8 | 29.0 ± 6.1* |
| Serum albumin (g/dL) | 2.6 ± 0.6*¶ | 2.9 ± 0.8 | 2.9 ± 0.6 |
| Serum urea (mg/dL) | 300 ± 93*¶ | 250 ± 115 | 121 ± 41* |
| Serum creatinine (mg/dL) | 14.9 ± 5.6*¶ | 11.2 ± 6.9 | 10.7 ± 4.0 |
| Serum cholesterol (mg/dL) | 173 ± 44¶ | - | 201 ± 51 |

†Baseline data from INNSZ and Hospital de Especialidades cohorts represent pre-dialysis values while baseline data from the ADEMEX study were drawn from patients already in dialysis (those incident patients were 0-3 months on dialysis); INNSZ: Instituto Nacional de la Nutrición Salvador Zubirán.
*p<0.05 *vs.* INNSZ. ¶p < 0.05 *vs.* ADEMEX. ‡Only mean value was drawn from the ADEMEX report.

**Table 6.** Comparison of patient and technique survival rates between 3 Mexican CAPD cohorts.

| | Hospital de Especialidades (%) | INNSZ[8] (%) | ADEMEX[9] (%) |
|---|---|---|---|
| Patient Survival | | | |
| 1 year | 90 | 85 | 85 |
| 2 years | 78 | NA | 68 |
| 3 years | 72 | 68 | NA |
| Technique Survival | | | |
| 1 year | 90 | 82 | NA |
| 2 years | 61 | NA | NA |
| 3 years | 50 | 61 | NA |

INNSZ: Instituto Nacional de la Nutrición Salvador Zubirán; NA: not available.

Compared with other Mexican CAPD cohort studies from other geographical areas,[8,9,12] patients from the Hospital de Especialidades seemed to initiate dialysis at a younger age, and with a more deteriorated general status (as judged by hematocrit, and serum levels of albumin, urea, creatinine and cholesterol) which, however, did not seem to be due to a lower CrCl. Patients from this cohort had larger BSA (as for a larger height) which, although not evaluated in this study, may influence the peritoneum transport characteristics. At the end of the follow-up, these patients improved some clinical and biochemical aspects (blood pressure, electrolyte and azotemia control), but others, associated with the nutritional status did not show any significant change (weight, hemoglobin, serum albumin and cholesterol). In spite of the latter, patient and technique survival was not significantly different from those other reported Mexican[8,9] and overseas series.[6,11,15]

In the current study, only older age and predialysis creatinine clearance significantly predicted mortality in multivariate analysis; according with other international studies were residual renal function was determinated.[16,17] It is interesting to note that these patients initiated dialysis with lower residual renal function than the suggested by K/DOQI guidelines.[18] Serum albumin and diabetes mellitus, have been repeatedly reported (including in Mexican series) as important predictors for mortality in peritoneal dialysis,[6,8,9,19,20] however, these variables did not play a significant role in the present study. The latter is intriguing, considering that our patients had lower serum albumin at baseline and a similar proportion of diabetes than other series; there is not a clear explanation, but an effect of our smaller sample size and probably younger age of patients and shorter time of follow-up cannot definitely ruled-out.

On the other hand, technique survival was similar to the reported in other Mexican[8] and overseas studies.[6,11,19] Similarly to others, peritonitis and older age[8-10,12,21] significantly predicted technique failure in our cohort. Albumin and diabetes[2,8,10,22] have been found as predictor for technique failure, but they were not significant predictors in the present study.

In conclusion, patients of this cohort from a single center of the west of Mexico were younger, had higher BSA and initiated peritoneal dialysis with a more deteriorated general status than patients reported in other Mexican series; in spite of the latter, patient and technique survival were not different. In our setting, pre-dialysis older age and lower CrCl significantly predicted mortality, while older pre-dialysis age and higher peritonitis rate predicted technique failure.

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