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Diabetic Patients and Peritoneal Dialysis

(Patients diabétiques et dialyse péritonéale)

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Summary

The prevalence of diabetes mellitus (DM) among patients requiring renal replacement therapy (RRT) has been on the rise worldwide, with DM now being the primary cause of end-stage renal disease (ESRD) in roughly one-third of RRT initiations. Although renal transplantation is the optimal treatment for ESRD, its limited availability has led to widespread use of in-center hemodialysis (HD) as the default RRT modality in many countries. However, peritoneal dialysis (PD) may be a superior option for diabetic patients due to its slower ultrafiltration rate, which can help mitigate the dialysis-induced hypotension and coronary ischemia that are associated with extracorporeal circulation during HD. Despite these advantages, unfounded concerns about technique failure and increased complication rates have discouraged some clinicians from recommending PD as a first-line RRT for diabetic patients.

We conducted a retrospective study comparing the incidence of complications and technique survival rates between diabetic and non-diabetic patients undergoing PD at a dialysis unit in Morocco. Our findings reveal that diabetic patients undergoing PD experienced no significant difference in technique survival or incidence of complications compared to non-diabetics. Nevertheless, only a small proportion (17.5%) of patients in our PD unit was diabetic, suggesting a need to improve access to PD for diabetic patients with ESRD.

Keywords: Diabetes, mechanical complication, peritonitis, peritoneal dialysis, renal failure

Résumé

La prévalence du diabète sucré chez les patients nécessitant une thérapie de remplacement rénal est en hausse dans le monde entier, et le diabète est désormais la principale cause d'insuffisance rénale chronique terminale (IRCT) responsable d'environ un tiers de ces patients. Bien que la transplantation rénale soit le traitement optimal pour l'IRCT, sa disponibilité limitée a conduit à l'utilisation généralisée de l'hémodialyse en centre (HD) comme modalité de remplacement rénal par défaut dans de nombreux pays. Cependant, pour les patients diabétiques, la dialyse péritonéale (DP) peut offrir une option supérieure en raison de son taux d'ultrafiltration plus lent, qui peut aider à diminuer les complications associées à la circulation extracorporelle pendant l'HD. Malheureusement, des préoccupations infondées concernant l'échec technique et l'augmentation des taux de complications ont dissuadé certains cliniciens de recommander la DP comme traitement de première intention pour les patients diabétiques en IRCT.

Nous avons mené une étude rétrospective comparant l'incidence des complications et les taux de survie de la technique entre les patients diabétiques et non diabétiques bénéficiant de la DP dans une unité de dialyse au Maroc. Nos résultats révèlent que les patients diabétiques en DP n'ont pas présenté de différence significative en termes de survie de la technique ou d'incidence de complications par rapport aux non diabétiques. Cependant, nous avons constaté que seule une petite proportion (17,5 %) des patients de notre unité de DP était diabétique, ce qui suggère que l'accès à la DP pour les patients diabétiques atteints d'insuffisance rénale chronique stade-V doit être amélioré.

Mots clés : Diabète, complication mécanique, péritonite, dialyse péritonéale, insuffisance rénale

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Introduction

The number of patients with diabetes mellitus (DM) who require renal replacement therapy (RRT) has increased globally. DM is now the leading cause of end-stage renal disease (ESRD), accounting for about one-third of all patients initiating RRT worldwide. ESRD poses a significant public health challenge and requires substantial resources, in terms of both finances and human capital [1]. In Morocco, diabetes accounts for 32.8% of all cases of renal failure [2]. While renal transplantation is the preferred treatment for ESRD, limited access has resulted in dialysis, mainly in-center hemodialysis (HD), being used in most countries [1]. However, Hong Kong, the Jalisco region of Mexico, and Guatemala have implemented peritoneal dialysis (PD) as the first-line treatment, with 71%, 61%, and 57% of ESRD patients receiving PD, respectively. The global rise in the number of ESRD patients is making it increasingly challenging for low- and middle-income countries to provide adequate dialysis access [3].

Peritoneal dialysis presents numerous benefits in comparison to hemodialysis and is therefore an appealing alternative. PD offers slow and sustained ultrafiltration, which is particularly beneficial for patients with multiple cardiovascular comorbidities, such as those with diabetes [4]. It reduces the risks associated with rapid ultrafiltration during HD, such as intradialytic hypotension, myocardial ischemia, and cardiac arrhythmias. PD also helps preserve residual renal function (RRF), which is especially important for diabetic patients. Moist et al. [5] found that PD patients had a 65% lower RRF loss than HD patients. Other benefits of PD include greater patient autonomy, reduced incidence of diabetic retinopathy flare-ups, lower doses of erythropoietin-stimulating agents to achieve hemoglobin goals, and a lower risk of contracting certain transmissible diseases, such as hepatitis C [6]. Despite these advantages, and the equivalent survival rates of PD and HD [7], patients with diabetes are typically referred to HD, regardless of medical evidence or patient preference.

The aim of this study was to analyze our PD unit's experience with peritoneal dialysis treatment for diabetics and compare the incidence of complications and the technique survival rates to those of non-diabetic patients.

Methods

We conducted a retrospective study that included all incident adult patients starting peritoneal dialysis at our dialysis unit in the Department of Nephrology at Hassan II University Hospital of Fez from January 2018 to December 2022.

This region, also called the Fez-Meknes region, is one of the 12 new regions of Morocco established by the 2015 territorial division. It covers an area of over 40,000 Km^2 and has a population of over 4.2 million people [8]. This region has seen a rapid increase in the number of hemodialysis units. In 2021, there were 51 hemodialysis centers; however, there was only one peritoneal dialysis center, located at our university hospital.

To identify diabetic patients, we used the diagnostic criteria of fasting blood glucose levels of ≥ 1.26 g/L or blood glucose levels of ≥ 2.00 g/L two hours after a glucose load [9].

Blood glucose levels were closely monitored and managed through a combination of dietary

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adjustments and sub-cutaneous insulin therapy, as indicated.

Peritoneal dialysis catheter insertion was performed by a nephrologist using mini-laparotomy under local or loco-regional anesthesia. A two-week observation period preceded dialysis initiation.

Peritoneal dialysis prescriptions for diabetic patients were individualized based on factors such as residual renal function, adequacy of dialysis, and fluid balance.

Dialysis was initiated for diabetic patients with the Continuous Ambulatory Peritoneal Dialysis (DPCA) method, utilizing Dianeal 1.36% solution. This method involved three exchanges daily, with an empty abdomen at night to facilitate adequate drainage and fluid balance. As patients progressed, a transition to Dialysis Prescription Automated Peritoneal Dialysis (DPA) was proposed. Under the DPA regimen, all eligible patients were transitioned to using a cycler. The DPA protocol entailed utilizing the Dianeal 1.36% solution for nightly dialysis sessions lasting 8-9 hours, allowing for four to five cycles. No Icodextrin or other non-glucose dialysat was used, due to their unavailability. The use of Dianeal 2.27% was limited to short periods to optimize fluid balance.

Our patients attended regular follow-up appointments with a multidisciplinary team comprising nephrologists, endocrinologists, dietitians, and diabetes educators. This collaborative approach ensured comprehensive oversight of each patient's medical condition and allowed for timely adjustments to their treatment plans as needed.

We collected the data from the patients' medical records, which were then processed using Microsoft Excel.

The statistical analysis employed in this study involved a comparison between diabetic and non-diabetic patients, with a specific focus on the incidence of complications and the technique survival rate. To achieve this, a combination of Kaplan-Meier survival analysis and the Cox proportional hazards model was utilized.

The Kaplan-Meier survival analysis was utilized to estimate and compare the technique survival rates of diabetic and non-diabetic patients. The log-rank test associated with the Kaplan-Meier analysis was applied to assess the statistical significance of differences observed between the two groups.

In addition, both bivariate and multivariate analyses using the Cox proportional hazards model were employed to perform a more refined assessment of the impact of diabetes technique survival while accounting for potential confounding factors. Covariates such as age, gender, and Charlson Comorbidity Index were considered in the model to adjust for their potential influence.

Results

The study included 80 patients who underwent PD, with a mean age of 47 +/-17 years and a sex ratio of 1.1 M/F. The main etiologies of ESRD were hypertension, glomerular nephropathies, diabetes, and polycystic kidney disease, in 25%, 25%, 17.5%, and 6.25% of cases, respectively.

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PD catheter insertion was carried out by a nephrologist under local anesthesia, through mini-laparotomy in 86.25% (69/80) of the patients and laparoscopy in 13.75% (11/80) of the patients. The mean follow-up time was 25 months [1-48], and the PD initation time was 14 +/-9.2 days after catheter insertion.

Out of the 80 PD patients, 14 were diabetics. The mean age of the diabetic patients was 62.5 +/- 14 years, and the sex ratio was 1.8 M/F. Half of the diabetic patients experienced mechanical complications, with initial catheter dysfunction and secondary migration being the most common, affecting 42.9% and 21.4% of cases, respectively. Infectious complications, mainly peritonitis, affected 50% of diabetic patients with a rate of 41 month-patient. The technique survival rate at 12 months was 57% for the diabetic patients, and the overall survival rate for diabetic patients over the 4-year study period was 78.6%. There was no statistically significant difference (p=0.44) in glycated hemoglobin levels before PD (6.77%) and three months after PD initiation (7%).

Univariate analysis showed no statistically significant difference in technique survival between the diabetic and non-diabetic groups, using the Kaplan-Meier survival analysis model (p=0.2) (Figure 1). There was also no statistically significant difference in the occurrence of mechanical or infectious complications between the two groups. However, there were statistically significant differences in age (p=0.005) and presence of hypertension (p=0.029) (Table I). The diabetic group had a higher incidence of catheter obstruction (14.3% vs. 1.5%, p=0.022), but there was no statistically significant difference in other types of mechanical complications (Table II).

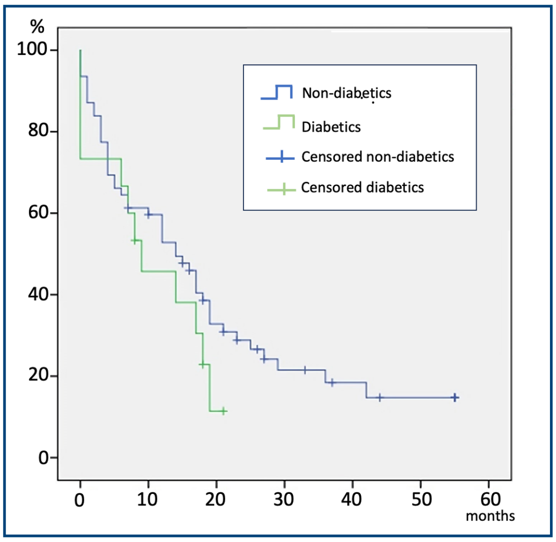

Figure 1. Comparison of technique survival between diabetic and non-diabetic patients, with no statistically significant difference between the two groups (p=0.257)

In the multivariate analyses using the Cox proportional hazards model to assess the technique survival rate, only mechanical complications had a statistically significant impact on technique survival, regardless of diabetic status (HR=1,842, IC95%: (1,10 – 3,07)).

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Table I: Univariate Analysis Comparing Diabetic and Non-Diabetic Groups

	Diabetics (N=14)	Non-Diabetics (N=66)	Total (N=80)	Sig (p)
Age	62.5 +/-14 years	41 +/-16 years	45 +/- 17 years	0.005
Sex ratio M/F	1.8	1	1.1	0.330
Hypertension	71.4% (10)	39.4% (26)	45% (36)	0.029
Cardiopathy	21.4% (3)	7.6% (5)	10% (8)	0.120
Conserved diuresis (>500 ml/day)	78.6% (11)	71.2% (47)	72.5% (58)	0.581
Body mass index (BMI)	24.4 +/- 4.2	22.5 +/- 3.3	22.8 +/- 3.5	0.157
PD start delay	14 +/- 4 days	14.5 +/- 10 days	14 +/-9.2 days	0.408
Mechanical complications	50% (7)	42.4% (28)	43% (35)	0.538
Infectious complications	50% (7)	43.9% (29)	45% (36)	0.683
Catheter replacement	28.4% (4)	25.8% (17)	26.3% (21)	0.831
Catheter removal	57% (8)	56.1% (37)	56.3% (45)	0.942
Switch to hemodialysis	50% (7)	42.4% (28)	43.8% (35)	0.609
Technique survival rate at 12 months after PD initiation	57.% (8)	56.1% (37)	56.3% (45)	0.407
Charlson Comorbidity Index	4.9 +/- 1.4	2.6 +/- 0.94	3 +/- 1.37	0.000

Table II: Comparison of Mechanical Complications between Diabetic and Non-Diabetic Patients

	Diabetics (N=14)	Non-Diabetics (N=66)	Total (N=80)	Significance (p)
Initial catheter dysfunction	42.9% (6)	24.2% (16)	27.2% (22)	0.161
Catheter obstruction	14.3% (2)	1.5% (1)	3.8% (3)	0.022
Catheter Migration	21.4% (3)	22.7% (15)	22.5% (18)	0.917
Dialysate leakage	0	1.5% (1)	1.3% (1)	0.648

Discussion

Peritoneal dialysis (PD) seems to offer comparable performance to hemodialysis in terms of clearance, volume control, and overall survival, while providing greater autonomy to patients [7]. Despite these advantages, only a small proportion of diabetics undergo PD. In our PD unit, only 17.5% of patients are diabetics. When comparing diabetic to non-diabetic patients, we found no statistically significant difference in terms of complications or technique survival, which is consistent with literature data [6, 7, 10]. However, we did observe a significant difference in survival between diabetics and non-diabetics, with the former experiencing lower survival rates due to comorbidities, particularly cardiovascular ones [11-13].

Despite PD's advantages, it presents some risks in diabetics that need to be taken into consideration when choosing this technique and when following up with these patients. One risk is the disruption of glucose and insulin homeostasis due to the significant glucose load provided by the dialysis solutions, resulting in a higher prevalence of hyperglycemia than that in hemodialysis patients [14]. Effective management of this risk involves tailored insulin dose adjustments and vigilant endocrinologist oversight upon PD initiation, coupled with the avoidance of high glucose dialysate solutions. These interventions yielded promising outcomes in our study, as evidenced by the absence of glycated hemoglobin elevation in all 14 patients. Notably, sub-cutaneous insulin administration was fine-tuned based on individualized considerations,

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including 72-hour self-monitoring glycemic cycles and a glycated hemoglobin target of 7%. It is worth noting that, despite the absence of icodextrin -- which could offer additional glucose load reduction if accessible -- in our unit, our approach exhibited positive results. There are currently no established guidelines for insulin dose adjustment, as patient responses to the glucose load can vary, influenced by factors such as peritoneal membrane characteristics [15]. Another risk is the higher incidence of metabolic syndrome, which is a major contributor to cardiovascular disease [16]. Controlling cardiovascular risk factors, such as hypertension and dyslipidemia, and promoting physical activity can help mitigate this risk. Patients with diabetes undergoing PD may also experience a rapid decline in residual renal function, which can be limited by prescribing renin-angiotensin-aldosterone system inhibitors (RAAS), avoiding nephrotoxic treatments, and preventing extracellular dehydration. 78.6% of our patients with diabetes still had conserved diuresis. Furthermore, a personalized and dynamic PD prescription that includes high-dose furosemide and the use of icodextrin and automated PD can be used to achieve better volume control in all PD patients, regardless of diabetes status. Finally, providing personalized training to each patient regularly can reduce the rate of peritoneal fluid infections [6].

While this study sheds light on patients with diabetes undergoing peritoneal dialysis (PD), it is constrained by its retrospective design, small sample size, and single-center setting (our peritoneal dialysis is one of the two major PD units in Morocco, the other one being in our capital city). These limitations could impact data accuracy and generalizability, potentially leading to biases and reduced statistical power. The study's scope might not fully capture long-term outcomes or patient perspectives, and its findings might not be broadly applicable to diverse healthcare settings. While the study provides valuable insights, cautious interpretation is warranted, and further research with larger cohorts, prospective designs, and comprehensive data collection is needed to corroborate and extend these findings.

Conclusion

Peritoneal dialysis is a safe and effective treatment option for diabetic patients with end-stage renal disease, as it seems to perform comparably to hemodialysis while offering greater patient autonomy. Although PD presents some risks in diabetics, these risks should not limit its prescription or contraindicate it in this population. Instead, they should be detected and prevented through appropriate management strategies. Practitioners should adopt an integrative approach to treating end-stage renal disease patients with diabetic nephropathy, beginning with peritoneal dialysis and switching to hemodialysis if problems arise.

Conflict of interest

The authors declare no conflict of interest for this article.

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