

ANALYSIS OF THE SURVIVAL RATE AND THE QUALITY OF LIFE IN PATIENTS WHO RECEIVED HAEMODIALYSIS AND PATIENTS WHO RECEIVED PERITONEAL DIALYSIS

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ABSTRACT

Background Patients with end stage renal disease (ESRD) who are about to start long-term dialysis therapy are faced with a question of modality choice. The aim of the current study is to determine the influence of different factors on long-term dialysis modality choice¹. Comparing the survival and quality of life for patients being treated with haemodialysis or peritoneal dialysis.

Methods We selected a part of the NECOSAD Study Group, this study included all new patients with ESRD; a total of 1,347 patients. Our dataset contained 706 patients with ESRD, 400 (56.7 percent) patients received haemodialysis as long-term dialysis therapy and 306 (43.3 percent) patients received peritoneal dialysis. We compared these two treatments with respect to survival and quality of life.

Results The survival rate of the haemodialysis group was better than the survival rate than the peritoneal dialysis group. Although it definitely matters what timeframe is used to calculate the survival rate, because of the fact that the peritoneal dialysis group on some timeframes has a better survival rate than the haemodialysis group. It may be caused by the age variable, because the mean of the haemodialysis is about 16 years higher than the mean of the peritoneal dialysis group.

The quality of life – expressed in terms of the EUROQol VAS Score and the PF10 – favours the peritoneal dialysis. On both scales the peritoneal dialysis group scored higher than the haemodialysis group; EUROQol VAS Score from 0.418 to 6.278 points higher (95% confidence interval) and Physical Functioning Score from 1.793 to 10.153 points higher (95% confidence interval) than the haemodialysis group.

Conclusions The quality of life in patients of the peritoneal dialysis group was better after twelve months, although the survival rate not always favours the peritoneal dialysis, the difference in survival rate between the two treatment groups was not that large.

APD and CAPD are easy to carry out and APD can be performed at night and the quality of life outcomes (EUROQol VAS Scores and Physical Functioning Score) favours the peritoneal dialysis treatment. According to our study results patients are wise to choose the peritoneal dialysis.

THE MAJOR DIFFERENCE between haemodialysis and peritoneal dialysis is that in haemodialysis the blood purification is outside the body and is often executed in a hospital or with help of a specialist and peritoneal dialysis can be performed at home and the blood purification is inside the body.

During haemodialysis the patients blood will be purified outside the body. The purification of the patients blood is achieved by a artificial kidney, the waste products and liquids are extracted from the blood and useful substances can be added to the bloodstream.

This purification is necessary because the kidney's (almost) failed to do so. A treatment will take about four hours and 30 minutes preparation. This has to be done three times a week. The treatment requires a arteriovenous fistula, thereby increasing forearm blood flow and allowing large-bore needles to be placed in forearm veins.

In peritoneal dialysis the dialysate is fed into the peritoneal cavity via a flexible tube and the peritoneum itself acts as a semi permeable membrane. The dialysate is replaced with fresh fluid when chemical equilibrium is reached.

There are two (major) forms of peritoneal dialysis, the most common in use, is the continuous ambulatory peritoneal dialysis (CAPD) which is performed four times a day. The technique is simple to learn and the vast majority of patients can carry out and supervise their own treatment at home. The other form of peritoneal dialysis is automated peritoneal dialysis (APD). Here the peritoneal fluid cycling is done by a machine, usually at night.

There are limitations to both treatments. Dialysis can not replace the functions of the kidney and the treatment is unnatural and invasive. The permeability characteristics of the artificial membrane in haemodialysis and, to a lesser extent, the peritoneum in peritoneal dialysis, are inferior to those of the physiological glomerular sieve.²

The study, from which the results are presented here, sought to demonstrate clinical differences between the two treatments. The differences which are the most important are survival and quality of life. Because this study is not a randomized clinical trial it is important to compare the baseline characteristics of the patients in the two treatment groups, when the two groups differ it is necessary to evaluate if the differences are significant and if that is the case; what is the (possible) effect of these differences on the results.

STATISTICAL ANALYSIS

SPSS software was used to perform all data and statistical analyses. The Variables were extracted from the dataset and p-values were calculated with the Pearson Chi-square tests and Independent samples t-tests (see Table 1).

The survival rate has been analysed with the Kaplan-Meier as shown in Figure 2. The method make allowance for the fact that not every patient can be followed to the end or the patient quit the study. However the calculations in this method are without any co-variables. A Cox-regression is necessary to include the co-variables.

The survival rate has also been analysed with the Cox-regression, the timeframe was 'Days in Study' and status was 'Patient died' (the event that a patient died). There were some covariates used to plot a Cox-regression curve; all the variables of the baseline characteristics were selected. The strata was the chronic therapy (haemodialysis or peritoneal dialysis). SPSS calculated the curves and the results are shown in Figure 3.

The calculations for the quality of life have been made with linear regression. Quality of life is expressed in terms of the EUROQoL VAS score and the PF10. We made three linear regressions; (1) Physical Function Score: PF12 and PF0, (2) EUROQoL VAS Score: EQ12 and EQ0, (3) Residual Kidney Function: GFR12 and GFR0.

The PF12, EQ12 and GFR12 were the dependent variables (PF0, EQ0 and GFR0 were the independent variables) and the calculations of these six variables (three pairs) were made separately from each other; i.e. PF12 and PF0 were not calculated in combination with EQ12 and EQ0, GFR12 and GFR0. The most important reason for this decision was that Physical Function score measures almost the same thing as EUROQoL VAS Score.

The other independent variables we used were: age, gender, blood iron level and cholesterol level. With adding these variables to the independent variables we have a larger perspective, the differences SPSS calculate are differences which respects the influences on the independent variable. These variables we selected could have an influence on the dependent variable, if we ignore or exclude them our conclusions may be false or incorrect. Our linear regression models are shown in Table 2, Table 3 and Table 4.

TABLE 1: BASELINE CHARACTERISTICS OF ALL PATIENTS

VARIABLE	HAEMODIALYSIS (N=400)	PERITONEAL DIALYSIS (N=306)	P-VALUE
Male Gender – n (%)	240 (60)	204 (67)	0.069
Age – year			0.050
Median	66	50	
Interquartile Range	23 – 90	19 – 80	
Smoking Habits – n (%)			0.063
Never smoked	120 (30)	109 (36)	
Smoked – stopped ≤ 3 months	13 (3)	15 (5)	
Smoked – stopped > 3 months	173 (43)	104 (34)	
Currently smokes	90 (23)	78 (25)	
Missing	4 (1)	0 (0)	
Primary Kidney Disease – n (%)			< 0.001
Diabetes Mellitus	69 (17)	35 (11)	
Glomerulo Nephritis	38 (9)	64 (21)	
Renal Vascular Disorder	94 (24)	35 (11)	
Other	199 (50)	172 (57)	
Davies co morbidity class – n (%)			< 0.001
None	113 (28)	226 (74)	
Mild	235 (59)	68 (22)	
Severe	52 (13)	12 (4)	
Residual Kidney Function – mL/mol/1,73m ²			0.004
Median	4.63	5.40	
Range	0.00 – 17.34	0.00 – 15.32	
Physical Functioning Score			< 0.001
Mean	44	61	
EUROQoL VAS Score			< 0.001
Median	55	60	

Blood Iron Level – mmol/L			< 0.001
Median	6.80	7.20	
Range	4.20 – 9.10	4.00 – 10.80	
Cholesterol – mmol/L			< 0.001
Median	4.80	5.50	
Range	1.80 – 10.00	2.94 – 11.80	

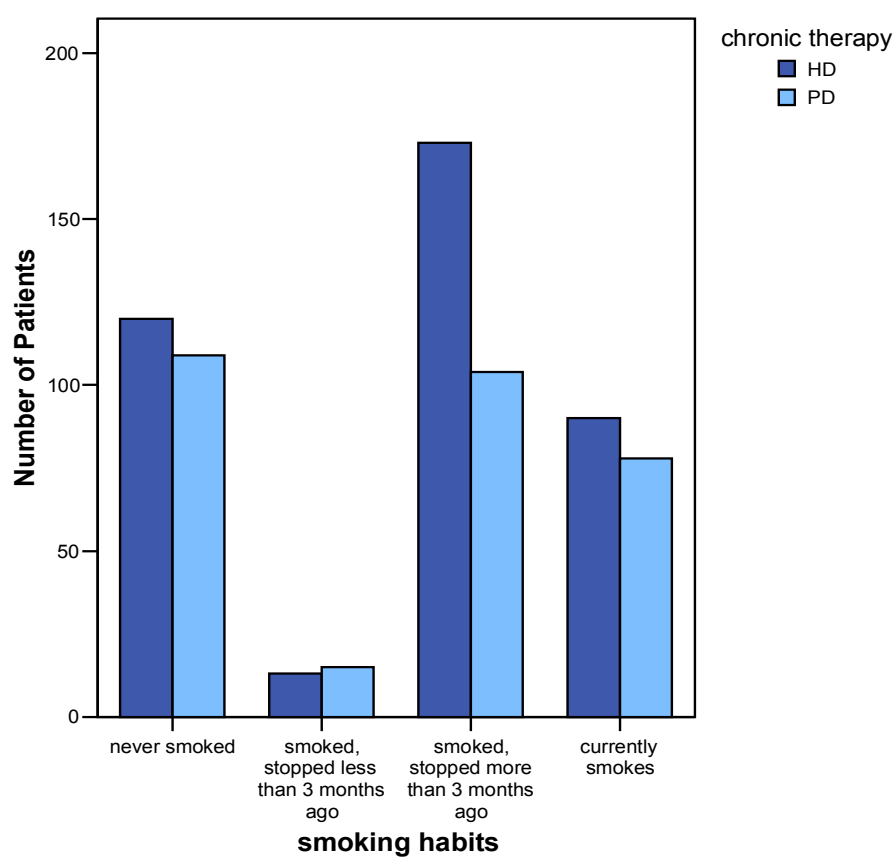


FIGURE 1 – SMOKING HABITS OF THE PATIENTS INCLUDED IN THE STUDY. THE DIFFERENCES OF THIS OUTCOME MAY INFLUENCE OUR CONCLUSIONS

RESULTS

Characteristics of the patients

A total of 706 patients were included in this study. The baseline characteristics of the patients are shown in Table 1. Of the total patients enrolled, 400 were assigned to the haemodialysis group and 306 were assigned to the peritoneal dialysis group. Two variables show a slightly significant difference between the two groups; Male gender ($p = 0.069$) and Smoking Habits ($p = 0.063$, Figure 1). One variable shows almost a significant difference between the two groups; Age ($p = 0.050$). Older people have an increased chance to die than younger people. We have to keep this in mind when we calculate the survival rate.

Negative smoking habits (currently smokes) increase the possibility to get a cardiovascular disease. Patients with end stage renal disease should be aggressive counselled to stop smoking. It influences the co morbidity (as pointed out in Table 1).³

The male gender has a slightly increased possibility to get a cardiovascular disease; not only men with end stage renal disease but also men in the human population. Therefore this difference is negligible, smoking however, is the variable which we have to keep in mind. Smoking has an influence on the survival rate and quality of life and therefore an influence on the outcome and conclusions of this study.

Survival

Both Kaplan-Meier and Cox-regression analyses have been made. As shown in Figure 2 the peritoneal dialysis has a much better survival rate than the haemodialysis. However the Kaplan-Meier analysis is not sufficient, because there may be some variables which have an influence on the survival rate; such as gender and age, therefore it is necessary to perform a Cox-regression analysis.

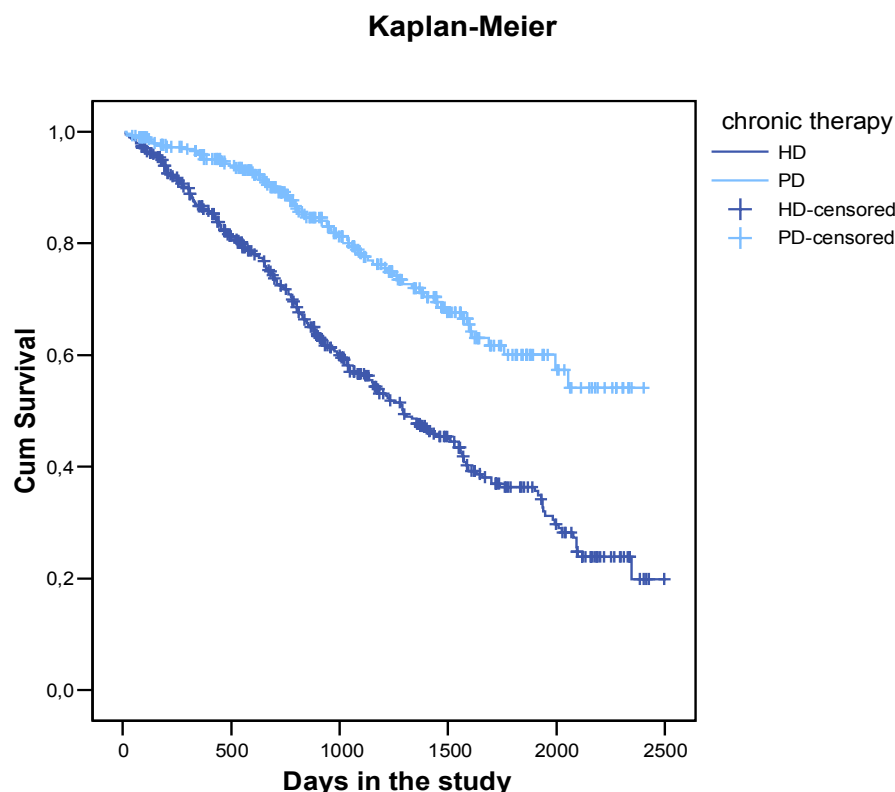


FIGURE 2 – KAPLAN-MEIER CURVE. AS SHOWN HERE SOME PATIENTS WERE CENSORED BECAUSE OF THE MISSING VALUES.

All variables of the baseline characteristics were selected to perform a Cox-regression. Figure 3 is quite the opposite of the Kaplan-Meier analysis. Haemodialysis has a better survival rate than peritoneal dialysis, although sometimes the peritoneal dialysis has a better survival rate. The Cox-

regression was significant ($p < 0.001$) and the selected co variables had (some) influence because the Kaplan-Meier shows quite different curves.

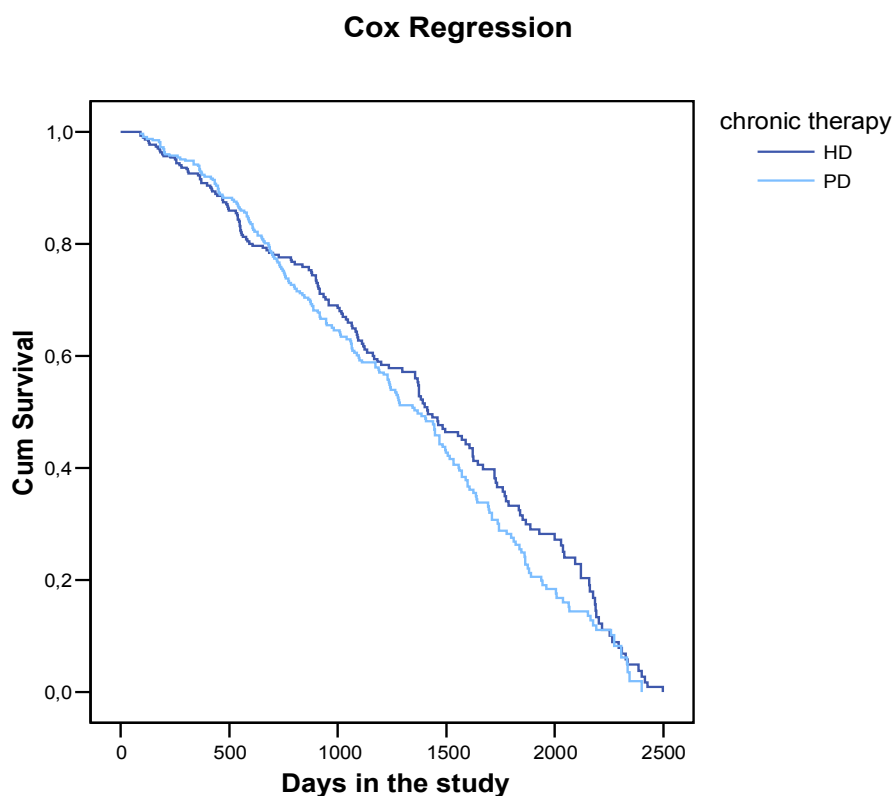


FIGURE 3 – COX REGRESSION WITH RESPECT TO THE VARIABLES WHICH MAY HAVE AN INFLUENCE ON THE SURVIVAL RATE OF BOTH THERAPIES.

It seems that the haemodialysis has a better survival rate, at the end of the curves (Cum Survival – 0.0) there is a difference of a 100 days. In case of survival a patient should choose for the haemodialysis. The survival rate of the haemodialysis may be even better when the selected patients were 16 years younger (the same mean as the peritoneal dialysis group).

Quality of Life

The quality of life is expressed in terms of EUROQoL VAS Score (Table 2) and PF10 (Table 3). We analysed these scores with linear regression. We also analysed the Renal Kidney Function (Table 4) the same way, because when the renal kidney function is (very) low the patient suffers from symptoms which have a serious negative effect on the lifestyle of the patient and if these symptoms cause a negative effect, the EUROQoL VAS Score and PF10 score will drop – i.e. Renal Kidney Function is also a variable which can express the quality of life.

TABLE 2: EUROQOL VAS SCORE (AFTER 12 MONTHS)

MODEL	UNSTANDARDIZED		STANDARDIZED		95% CONFIDENCE		
	COEFFICIENTS		COEFFICIENTS		INTERVAL FOR B		
	B	STD. ERROR	BETA	T	SIG.	LOWER BOUND	UPPER BOUND
Constant	34.400	6.845		5.026	0.000	20.947	47.852
Age	0.008	0.047	0.008	0.167	0.868	-0.085	0.101

Gender	-1.560	1.341	-0.048	-1.163	0.245	-4.197	1.076
Blood Iron Level*	0.123	0.692	0.008	0.177	0.860	-1.237	1.482
Cholesterol*	0.062	0.487	0.005	0.128	0.898	-0.895	1.019
EUROQol VAS Score	0.421	0.034	0.510	12.497	0.000	0.355	0.488
Chronic Therapy	3.348	1.491	0.108	2.246	0.025	0.418	6.278

* mmol/L

Blood Iron Level, Cholesterol and EUROQol VAS Score at baseline

The linear regression model for EUROQol VAS Score contains important data; when we look at chronic therapy (bold and italic), we notice that the B value is 3.348. In this dataset peritoneal dialysis has the value '2' and haemodialysis has the value '1'. That means that if all the independent values are the same for a patient in the haemodialysis group and a patient in the peritoneal dialysis group the difference in the EUROQol VAS Score is 3.348 – i.e. a patient with the score of 0 in the haemodialysis group and there is a patient in the peritoneal dialysis group with the same values for all the independent variables, than this patient will have a score of 3.348 (95% CI 0.418 – 6.278).

The patients who received peritoneal dialysis would have a higher EUROQol VAS Score, with 95% of the patients between 0.418 and 6.278 points above the haemodialysis patients with (almost) the same values for the independent variables.

TABLE 3: PHYSICAL FUNCTIONING SCORE (AFTER 12 MONTHS)

MODEL	UNSTANDARDIZED		STANDARDIZED		95% CONFIDENCE		
	COEFFICIENTS		COEFFICIENTS		INTERVAL FOR B		
	B	STD. ERROR	BETA	T	SIG.	LOWER BOUND	UPPER BOUND
Constant	36.071	9.605		3.755	0.000	17.197	54.946
Age	-0.282	0.069	-0.148	-4.094	0.000	-0.417	-0.147
Gender	-5.479	1.897	-0.094	-2.888	0.004	-9.207	-1.751
Blood Iron Level*	0.283	0.989	0.009	0.286	0.775	-1.660	2.225
Cholesterol*	0.059	0.687	0.003	0.086	0.931	-1.290	1.409
Phys. Func. Score	0.617	0.035	0.604	17.805	0.000	0.549	0.685
Chronic Therapy	5.973	2.127	0.106	2.808	0.005	1.793	10.153

* mmol/L

Blood Iron Level, Cholesterol and Physical Functioning Score at baseline

The same way we analysed the EUROQol VAS Score, we analyse the Physical Functioning Score after 12 months. The B value for chronic therapy is 5.973 and that means that patients in the peritoneal dialysis group have a structural higher score than the patients in the haemodialysis group.

The patients who received peritoneal dialysis would have a higher Physical Functioning Score, with 95% of the patients between 1.793 and 10.153 points above the haemodialysis patients with (almost) the same values for the independent variables.

TABLE 4: RESIDUAL KIDNEY FUNCTION (AFTER 12 MONTHS)**

MODEL	UNSTANDARDIZED		STANDARDIZED		95% CONFIDENCE		
	COEFFICIENTS		COEFFICIENTS		INTERVAL FOR B		
	B	STD. ERROR	BETA	T	SIG.	LOWER BOUND	UPPER BOUND
Constant	-2.631	1.163		-2.263	0.024	-4.916	-0.347
Age	0.000	0.009	0.001	0.022	0.983	-0.017	0.017
Gender	0.054	0.240	0.009	0.226	0.821	-0.417	0.526
Blood Iron Level*	0.387	0.129	0.130	3.000	0.003	0.133	0.640
Cholesterol*	0.025	0.090	0.012	0.280	0.779	-0.152	0.202
Res. Kidney Func.**	0.402	0.038	0.443	10.694	0.000	0.328	0.475
Chronic Therapy	0.158	0.274	0.029	0.578	0.564	-0.380	0.696

* mmol/L

** mL/min/1.73m²

Blood Iron Level, Cholesterol and Residual Kidney Function at baseline

We extracted the B value of the chronic therapy of the Residual Kidney Function the same way we extracted the B values of the other two variables. What we see here is that the 95% confidence interval and the p value ($p = 0.564$) are not statistically relevant. This linear regression has been corrected for two measurement values at the peritoneal dialysis group (explained right below Figure 6) and because of the correction the outcome became statistically irrelevant.

If the model was significant the peritoneal dialysis group had a slightly better residual kidney function than the haemodialysis group and sometimes, but there are also patients with a slightly worse residual kidney function than the patients in the haemodialysis group (see the 95% confidence interval).

These findings were supported by the error bars we made. Each figure contains 4 error bars; the first two bars display the means of EUROQol VAS Score, Physical Functioning Score and Residual Kidney Function for haemodialysis – including 95% Confidence Interval – and the second two bars display the same for peritoneal dialysis (Figure 4, Figure 5 and Figure 6).

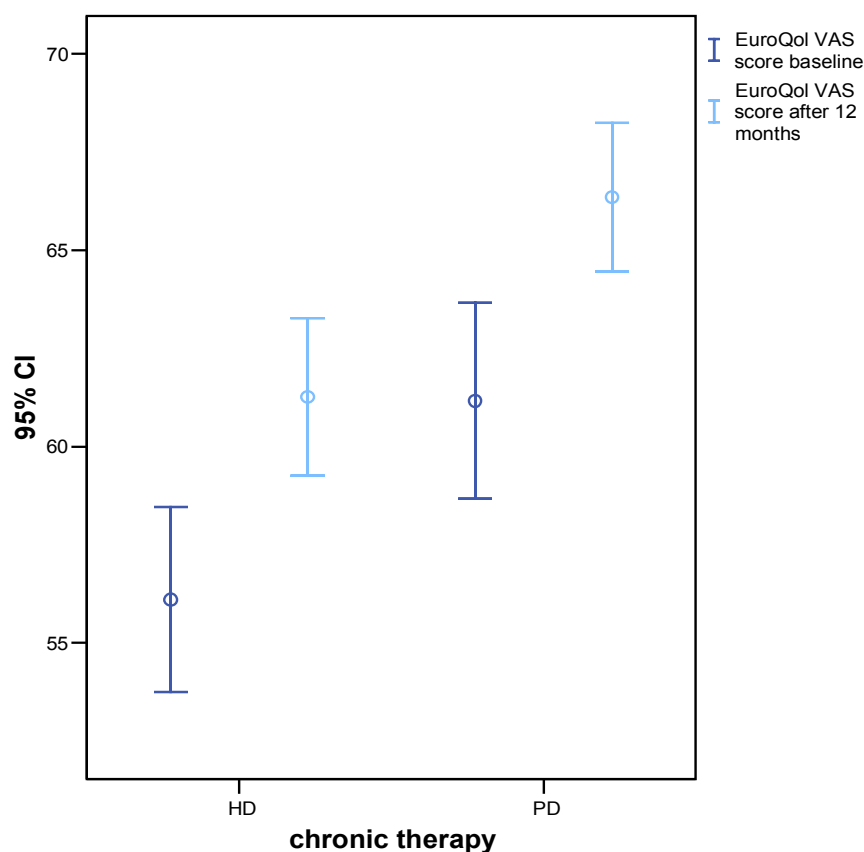


FIGURE 4 – ERROR BARS OF THE EUROQOL VAS SCORE AT (1) THE BEGIN (EQ0) AND (2) AFTER 12 MONTHS (EQ12).

As we see here the peritoneal dialysis groups scores higher results, the EQ12 of the haemodialysis is as high as the EQ0 of the peritoneal dialysis group. The haemodialysis group contained 26 missing values for EQ0 and 133 missing values for EQ12. The peritoneal dialysis group contained 15 missing values for EQ0 and 78 missing values for EQ12. The missing values may have some influence on the outcomes.

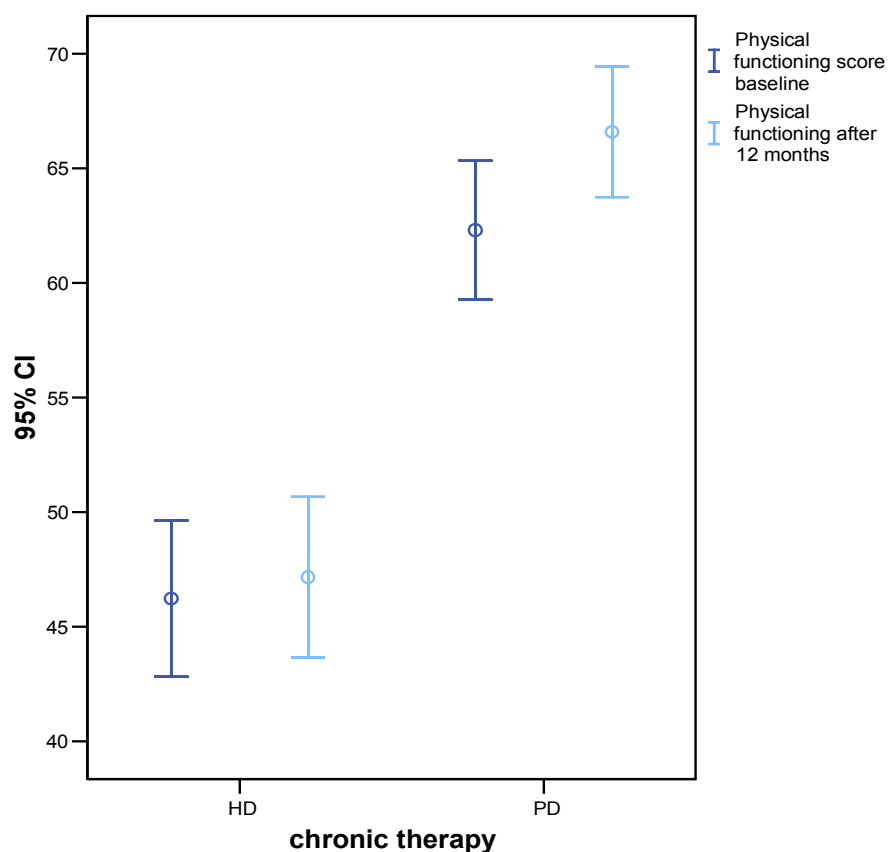


FIGURE 5 – ERROR BARS OF THE PHYSICAL FUNCTIONING SCORE AT (1) THE BEGIN (PF0) AND (2) AFTER 12 MONTHS (PF12).

Again the peritoneal dialysis group scores higher results. Not even one 95% confidence interval overlaps one other. The two treatment groups have complete different scores. The 95% confidence interval of PF12 of the haemodialysis group differs almost 8 points with the 95% confidence interval of PF0 of the peritoneal dialysis group. Zero cases were missing for the PF0 value, the haemodialysis group contained 123 missing values for PF12 and the peritoneal dialysis group contained 76 missing values for this variable.

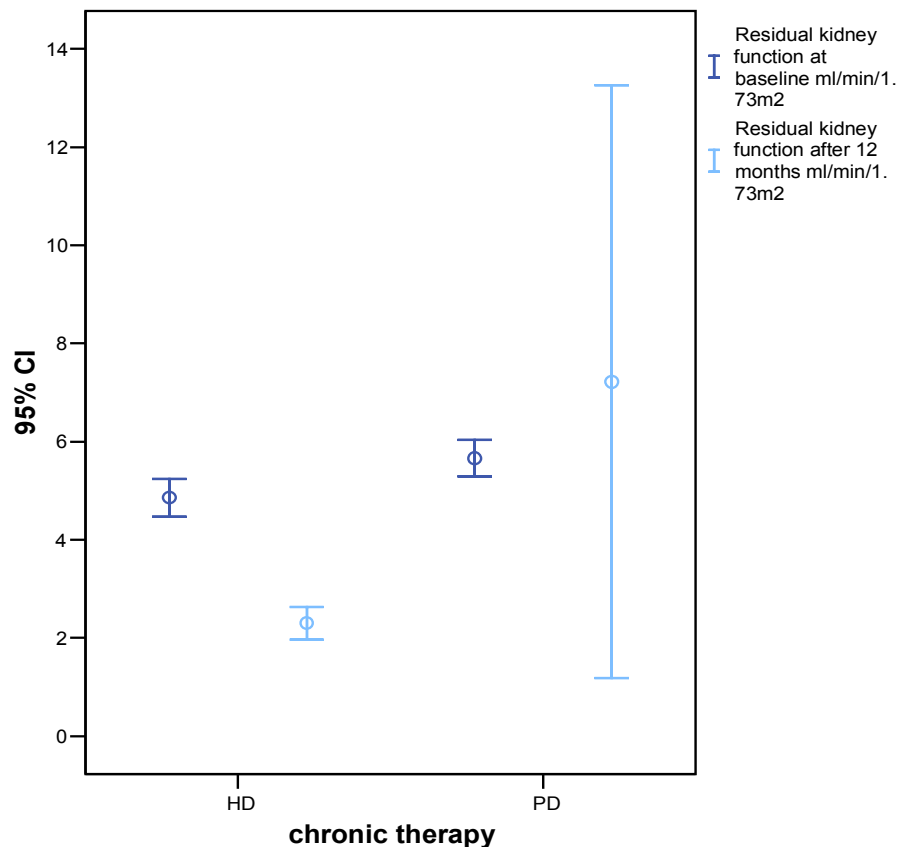


FIGURE 6 - ERROR BARS OF THE RESIDUAL KIDNEY FUNCTION AT (1) THE BEGIN (GFR0) AND (2) AFTER 12 MONTHS (GFR12).

The eye-catcher of this figure is the last error bar; the 95% confidence interval is wide, probably caused by two values for the GFR12 within the peritoneal dialysis group. All values for GFR12 in both groups varies between zero and twenty, these two values – which probably caused this wide ranged 95% confidence interval – were 379.04 and 599.20. The normal Glomerular Filtration Rate (GFR) is about 120 mL/min/1.73m², so it appears that these two values are measurement errors.⁴ See Figure 7 for the correction (erasure of the two measurements).

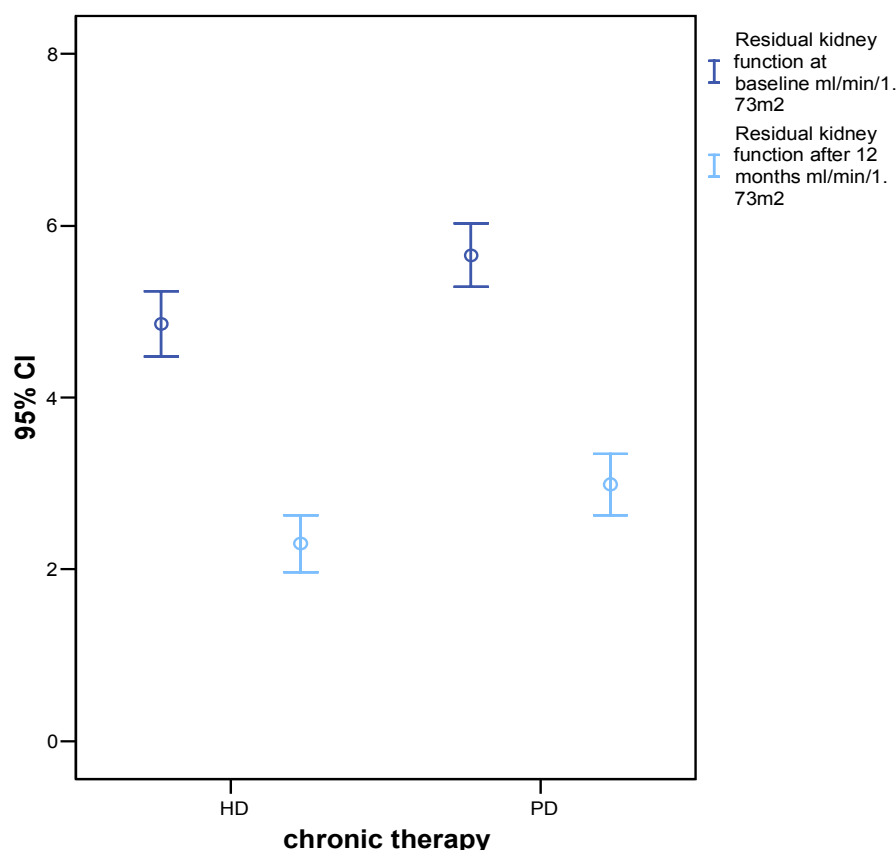


FIGURE 7 – CORRECTED FOR THE TWO VALUES WHICH WERE HIGHLY UNUSUAL VALUES FOR THE KIDNEY FUNCTION.

The peritoneal dialysis group showed a slightly better residual kidney function after 12 months, what was not confirmed by the linear regression model for residual kidney function. In some cases the haemodialysis showed a better result than the peritoneal dialysis in case of the residual kidney function and therefore it is not a good measurement for quality of life.

It has to be said that the residual kidney function in both therapies has dropped after 12 months. It is quite logic that this happens because the patients suffer from ESRD, which causes the drop of the residual kidney function.

DISCUSSION

Both treatments have a heavy impact on the patient's life, the treatments are invasive and the patient has to adapt its life to survive. The overall survival rate of patients with haemodialysis is slightly better than patients with peritoneal dialysis. Although sometimes the survival rate is better in patients with peritoneal dialysis; in other words the survival rate is an important factor, but in our study does it barely differ between haemodialysis and peritoneal dialysis. This may be caused by the difference in the age variable; the haemodialysis group is about 16 years older than the peritoneal dialysis group.

The quality of life is definitely different in the two treatment groups. The EUROQoL VAS Score and the Physical Functioning Score both favours the peritoneal dialysis, patients in this treatment group scored higher than the patients in the haemodialysis group. Residual Kidney Function is not a good prediction for the quality of life, the tests we performed were not statistically significant. Although the effectiveness of the peritoneal dialysis treatment seems to be better than the haemodialysis treatment, but further research is necessary to verify this.

APD and CAPD (the two forms of peritoneal dialysis) are easy to carry out and can be done at home (is much easier than perform a haemodialysis). APD is the automatic form and can be done at night, CAPD has to be performed 24 hours a day, seven days a week.

The outcomes of our study favours the peritoneal dialysis although the survival rate is in some cases better in the haemodialysis group. According our study results patients are wise to choose the peritoneal dialysis.

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