COST-EFFECTIVENESS OF DIETARY NUTRITIONAL TREATMENT IN CKD

Fordellone Mario[1], Bellizzi Vincenzo[2], Signoriello Simona[1], Minutolo Roberto[3], De Nicola Luca[3], Quintaliani Giuseppe[4], Di Iorio Biagio[5], Chiodini Paolo[1]

[1]Medical Statistics Unit, University of Campania "Luigi Vanvitelli", Naples (Italy)
[2]Division of Nephrology and Dialysis, "Sant'Anna e San Sebastiano" Hospital, Caserta (Italy)
[3]Division of Nephrology, University of Campania "Luigi Vanvitelli", Naples (Italy)
[4]Nephrology Unit, Perugia Hospital, Perugia (Italy)
[5]Nephrology Unit, Moscati Hospital, Avellino (Italy)

Introduction

The healthcare spending is progressively growing because of increasing population, rising age, expanding chronic disease incidence and prevalence, higher health service utilization, growing prices and innovations of health care products and services [1,2].
Kidney diseases had rapidly expanded in the last decades, currently affecting more than 850 millions of individuals [5]. The renal replacement treatment (RRT) of end stage renal disease (ESRD) has extremely high costs, which are not sustainable for many low-income but also some high-income countries, and consequently the life-threatening RRT is not affordable for all worldwide ESRD patients, resulting in millions of avoidable deaths for renal disease every year [6]. Hence, new approaches for more cost-effective RRTs are needed [7]. Nonetheless, the costs in nephrology are not limited to RRTs, but also non-dialysis chronic kidney disease (CKD), which represents the vast majority of the of renal diseases, is burdened by high costs for the society, either health systems or patients, including young individuals and early CKD stages patients, and more cost-effective preventive strategies to avoid or slow-down CKD progression are needed [3-5].
Given the limited resources, before any preventive treatment is introduced at large into the clinical practice, beyond the impact on patient's health, it should be carefully analyzed the cost to benefit ratio of the strategy.

Aims

The purpose of this study is to evaluate in CKD patients with proven adherence to diet compared with matched-control CKD patients not receiving any diet, the overall costs associated to the low-protein diets, represented by the economic cost and the individual cost in terms of mortality and delay of dialysis

Methods

Continuous variables were reported as either the means and standard deviation or median and interquartile ranges (IQRs) according to their distribution, as assessed by the Shapiro-Wilk normality test. Categorical variables were reported as percentages. Differences in characteristics of patients be-tween treated group and control group were expressed in terms of standardized differences and they were tested by t-test or Wilcoxon test (according to their distribution) and Pearson chi-squared test for continuous and categorical variables, respectively.
Since the recipients of treatment differed from the non-recipients (i.e., control group) in terms of the baseline characteristics, propensity scores were calculated and used to match the treated group and control group with respect to the baseline covariates. The propensity score is the conditional probability of having the treatment given a vector of measured covariates. In this case, the covariates included in the propensity score matching (PSM) were sex, BMI, eGFR, and CVD. We calculated propensity score for each patient, using the MatchIt R package, with the following set-up: multivariable logistic regression model with link probit, nearest approach, caliper equal to 0.1 and a 1:2 ratio. The matched data was obtained using the Matching R package.
To assess prognosis of CKD patients according to stage IV to V, we used ESRD and death be-fore ESRD as outcomes. The differences in prognosis between treated group and control group were tested by log-

rank test and represented by Kaplan-Meier curves. Median follow-up was estimated by the inverse Kaplan-Meier approach.

Results

Median follow-up to end stage renal disease (ESRD) was 77.5 months (95% CI, 66.3 to 105.7) for the treated group and 50.5 months (95% CI, 38.5 to 57.7) for the control group. The median to ESRD was 48.6 months (95% CI, 33.8 to 72) for the treated group and 28.8 months (95% CI, 25 to 41.7) for the control group, with a statistically significant log-rank test equal to 0.017 (Figure 1a). The number of ESRD events were equal to 40 (65%) for the treated group and 75 (61%) for the control group. Median follow-up on the overall survival (OS) was 84.1 months (95% CI, 77.9 to 97.5) for the treated group and 60.5 months (95% CI, 57.7 to 62.8) for the control group. The median to event was 107 months (95% CI, 96.2 to 114.5) for the treated group and 86.6 months (95% CI, 66.3 to 103.8) for the control group, with a statistically significant log-rank test equal to 0.004 (Figure 1b). The number of deaths were 19 (31%) for the treated group and 46 (37%) for the control group. Table 1 shows the results obtained in terms of saving costs. In particular, on the median follow-up time (i.e., 60 months) there was a savings of 25.29%, on the ESRD median time of the treated group (i.e., 49 months) there was a savings of 27.67%; finally, on the ESRD median time of the control group (i.e., 29 months) there was a savings of 30.43%.

Conclusions

The nutritional therapy for kidney disease is costly because of the artificial food substitutive of protein-based food (aproteic food), other nutritional supplements (vitamins, ketoanalogs, etc.) and the need of a more intensive care of these patients by professional (dietitians, nephrologists, etc.).
Whether the increase of costs due to the low-protein diet in CKD can be balanced, in terms of individual and health system savings, by the possible delay of dialysis start, remains to be determined.
In this study was proved that in CKD patients with proven adherence to diet compared with matched-control CKD patients not receiving any diet, the overall costs associated to the low-protein diets, represented by the economic cost and the individual cost in terms of mortality and delay of dialysis were decreased. In other words, the survival analysis proves that the aproteic diet delays the time to ESRD of patients, it improves the overall survival and then, it leads a saving of costs and the human lives.

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Figure 1 – (a) Estimated Kaplan-Meier curves to ESRD and 95% confidence interval for control group and treated group; (b) Estimated Kaplan-Meier curves on OS and 95% confidence interval for control group and treated group. p indicates the log-rank test p-value on the difference between groups

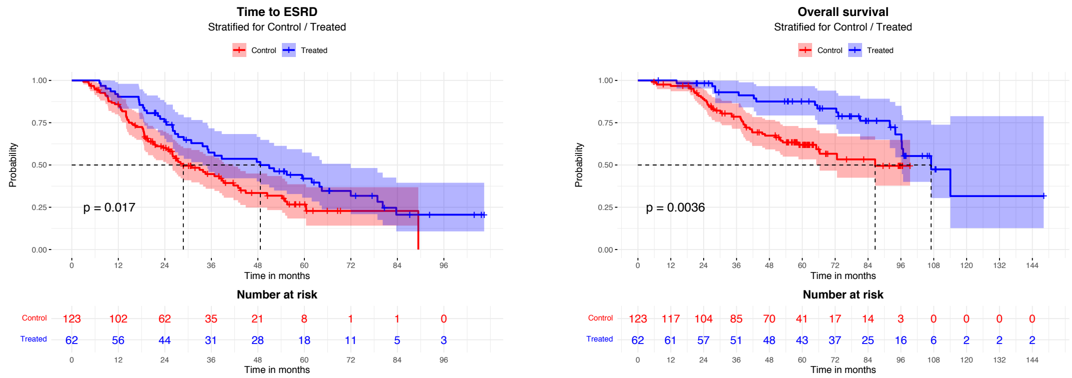

Table 1 – CKD costs summary table for three survival time points

Disease stage	*Costs*	Control	Treated	Δ	Δ (%)
CKD, *29 months* (ESRD median survival for control group)	*Total, €*	51,259.58 €	35,661.58 €	-15,598.00 €	-30.43%
	Yearly, €	21,207.94 €	14,754.48 €	-6,453.45 €	
	ESRD, %	50%	35%	---	---
	Death, %	18%	7%	---	---
CKD, *49 months* (ESRD median survival for diet group)	*Total, €*	122,855.10 €	88,862.96 €	-33,992.14 €	-27.67%
	Yearly, €	30,089.42 €	21,764.13 €	-8,325.29 €	
	ESRD, %	67%	50%	---	---
	Death, %	33%	13%	---	---
Overall, *60 months* (median follow-up)	*Total, €*	166,058.20 €	124,054.20 €	-42,004.00 €	-25.29%
	Yearly, €	33,211.64 €	24,810.84 €	-8,400.80 €	
	ESRD, %	73%	52%	---	---
	Death, %	38%	13%	---	---