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Differing dialysis treatment strategies and outcome

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Abstract. The choice of a dialysis treatment depends on many factors, both medical and non-medical. A full and rational treatment requires easy access to a transplantation programme and to all dialysis modalities, extracorporeal or peritoneal. Presently, haemodialysis (HD) is used almost exclusively for in-centre or limited care treatment, peritoneal dialysis (PD) being preferred for home treatment. On HD, bicarbonate buffer is used in preference to acetate. Mixed convective-diffusive HD techniques have a very limited utilization world-wide because of their cost. Use of PD and automated PD continues to grow, although slowly. In our single-centre experience on a large number of patients, 10-year patient survival is not different on CAPD and HD, and there is initial lower risk of death on CAPD for patients ≥ 75 years of age. Drop-out from CAPD has increased in recent years, mainly due to the patient/partner 'burn-out'. Drop-out is less for the elderly, and the difference in modality change between CAPD and HD decreases with increasing patient age, suggesting a clear indication for CAPD in the elderly, or in adults waiting for a transplant. The clinical background, e.g. the presence of diabetes mellitus, cardiovascular disease, dyslipidaemia or obesity, is also important in the choice of method.

Key words: adequacy; haemodialysis; nutrition; peritoneal dialysis; transplantation; uraemia

Introduction

Availability of a good transplantation programme can influence the choice of dialysis method. Patients suitable for a graft may need dialysis for a limited period of time. In our experience over the last 10 years, with an average of 30 transplants per year, 50% of patients of our province have a graft within 18 months, and 80% within 5 years, without significant differences between patients more and less than 44 years age old. The HLA phenotype and the ABO antigens are excellent indicators of the likelihood of receiving a graft in a limited time, and this should also influence the choice of dialysis treatment.

Transplantation results for patients coming from continuous ambulatory peritoneal dialysis (CAPD) or haemodialysis (HD) are very similar in the general experience, as in our experience [1] (Figure 1). Thus, for patients having access to a good transplantation programme and not having a very rare HLA phenotype, CAPD is, in our opinion, the best choice, as it is a home-based and cheaper dialysis regimen than in-centre HD. It assures better maintenance of residual diuresis, thus making it possible to readily reach the optimal dialysis dose, and to obtain the same patient survival and probably better clinical conditions.

A further point in favour of PD is the reduced risk of becoming infected by hepatitis viruses. The prevalence of HBV and HCV infection is greater on HD than on CAPD [1], and for HCV it increases with time, whereas it is stable or tends to decrease on CAPD [2]. Dialysis at home (PD or HD) is the most appropriate way to reduce the risk of having a virus infection transmitted.

Dialysis options world-wide

For patients not having easy access to, or not suitable for transplantation, the problem arises of which dialysis modality to advise. The principal choice is between intracorporeal or extracorporeal dialysis. Extracorporeal modalities have proliferated in recent years; thus

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dialysis therapy has, nowadays, many alternatives [haemofiltration (HF), haemodiafiltration (HDF), biofiltration (BF), acetate-free biofiltration (AFB), paired filtration–dialysis (PFD), high-flux dialysis (HFD)]. For intracorporeal treatment the choice is, today, between CAPD and automated, mainly nocturnal PD, which has several possibilities that can be tailored to the patient's physical, psychological or social needs.

Among the extracorporeal treatments, what is the penetration of the new techniques? According to data from commercial companies, bicarbonate dialysis is now the dominant modality world-wide, with acetate HD contributing less than 20% and progressively disappearing, as has already happened in Canada. Haemofiltration is also disappearing world-wide. The use of HDF and acetate-free HD is moderate in Europe, very low in Japan and world-wide, and almost zero in USA and Canada. In Europe, Italy has the highest use of these expensive methods of treatment, followed by Austria, Poland, France and others, the average in the entire EDTA Registry being about 8% [3].

In the USA, about 74% of patients receive a low-flux and 4% an intermediate flux dialysis (commercial data), making use of cellulose membranes, often with large surface areas to increase the dialysis dose and reduce the time of treatment. About 22% of patients receive a high flux dialysis, using synthetic membranes in order to obtain a more biocompatible dialysis.

The clinical impact of the new convective–diffusive treatments is disputed. HDF certainly improves the dialysis efficiency, and post-dialysis, but not predialysis, β₂-microglobulin is less [4]. The intradialytic symptoms are slightly, but not significantly, improved, however there is widespread conviction that in hypotensive-prone patients this treatment enables better cardiovascular stability [4].

In a cross-over study on elderly patients by Movilli et al. [5], hypotensive episodes were significantly less on HDF and AFB than on bicarbonate HD. Are the above differences important enough to justify the significantly higher costs of these treatments in comparison to standard HD treatments and to CAPD? We believe that the application of these techniques should be very selective, and in hypotensive-prone patients the CAPD alternative should be kept in mind.

On the other hand, PD use is continuously increasing, reaching at the end of 1994 95 000 patients, with a yearly growth rate of 15% in the last 4 years, greater than that of HD (data from Baxter Co.). World-wide, 16% of all dialysis patients are being treated with PD. In Europe, according to the EDTA Registry, the proportion of patients treated by PD is very different from country to country, from a low percentage to about 50% in the UK [3].

In our centre about one-third of patients are treated with PD, and of the HD patients only 7% are treated with mixed techniques, i.e. HDF and AFB.

In recent years APD has had increasing success and its growth rate has been greater than that of CAPD in the USA (data from Baxter Co.). APD advantages are an increased clearance of small molecules; lower clearance of middle and large molecules, with reduced protein loss; lower intra-abdominal pressure due to recumbency, with lower incidence of hernia, leakage and hemorrhoids; more appetite; less negative 'self-image'; and more diurnal 'free time' with positive effects on psychological stability and working capacity. APD also has negative aspects: solute transfer does not significantly improve in patients with poor peritoneal permeability; clearance of middle molecules is lower; and training more difficult. There is, again, machine dependence, cost is greater, and mobility (for travel, holidays) is reduced.

Comparison between CAPD and HD

Nissenson et al. [6] have recently investigated factors influencing the choice of dialysis treatment world-wide. The results clearly show that non-medical reasons are the principal determinants. The most important are government-imposed economic limitations, physician bias, resource availability, social, religious and cultural factors, geographic distance to dialysis units, availability of transportation, apartment dwelling, supportive family environment and patient bias.

Besides these, and often less important to the final choice, the medical factors influencing method selection are patient survival on the method, method survival, rehabilitation and quality of life, patient age and co-morbidity.

The best comparison between CAPD and HD is by their survival curves. Many studies have demonstrated that survival on CAPD does not differ from that on HD, up to 5–6 years follow-up. We have re-evaluated our data to extend these curves to a 10 year follow-up, considered adequate for a conclusive statement [7]. A total of 578 new patients have been followed in our institution from 1981 to the end of 1993, 51% on CAPD and 49% on HD. Dividing patients into age groups, only those 45–65 years old had different observed survival. After adjusting for case mix, with Cox analysis, survival difference also disappeared for this age group (Figure 2). For patients ≥75 years of age, observed and adjusted survivals are better on CAPD for the first years, this advantage disappearing with longer time, probably due to the worsening residual renal function. Method survival is, on the contrary, definitely worse on CAPD, and in our experience the difference with HD increased with time [7]. One explanation of this is that drop-out is now negligible on HD, due to the availability of new dialytic methods (bicarbonate HD, haemodiafiltration and others) able to improve the dialysis tolerance (Figure 3). Causes for this intra-dialysis change were dialysis hypotension and intolerance in 74%, need for greater dialysis efficiency in 20%, and investigation reasons in 6%. Obviously, as the new methods assure better dialysis tolerance we prefer to avoid placement of a peritoneal
Patient age and method choice

In spite of the highest difference in retention in favour of HD, children are probably the best candidates for PD, CAPD or, better, automated PD. First of all, children usually remain on treatment for limited periods of time, being rapidly transplanted. Secondly, CAPD makes it possible to treat children in the first 2 years of life who may not have previously been treated. Dietary restrictions are not as severe as on HD, and additional caloric intake (9–18 calories/kg/day) comes from peritoneal glucose absorption. There is improved growth (further improved by human recombinant growth hormone) and improved control of hypertension. Haemoglobin is maintained at a higher level, with lower need for EPO supply, and this allows enhanced exercise tolerance. Children can have relatively normal social relationships, school attendance is much easier, and this improves exercise, diet, growth and rehabilitation. In conclusion, quality of life of patients and their parents improves. In a recent review, Alexander et al. reported that at the end of 1989 PD accounted for 50% of pediatric patients (i.e. <15 years old) in the USA, 65% in Canada and 75% in Australia.

Retention on treatment

For patients to be maintained on dialysis for long periods of time, analysis of retention on the method is necessary. This analysis takes into account method failure for patient death and for drop-out due to all causes, except transplantation, recovery of renal function and transfer to other centres that are considered as loss to follow-up. Retention on CAPD is significantly less than on HD in children and adults, and this is particularly true for patients 15–45 years old. The difference decreases with patient age, and in patients 65–75 years old it becomes evident only after 3 years of treatment. However it must be considered that, according to the Lombardy Registry, life expectancy in our region is, for such patients, between 3 and 4 years (unpublished data). Finally, for patients above 75, retention on CAPD is not at all different from that on HD.

catheter, and training the patient and the partner to use PD at home.

However, the increasing difference between HD and CAPD is also due to the increase in CAPD drop-out, changing, in our experience, from 11.7% in the period from 1981–1987 to 15.8% in 1987–1983. Mean age increased from 60 to 64 years. The increased drop-out was almost entirely due to the patient’s or partner’s wishes, not influenced by the clinical staff, to abandon the method (from 2.5% to 9.1%), for psychological, working, social or transport reasons. Drop-out was influenced by patient age, and it was about three times less in elderly than in the youngest patients, and similar differences were seen for all causes, more evident for peritonitis.

Fig. 2. Adjusted patient survival of CAPD and HD patients, according to age group. For the group 15–45 years only observed survivals are reported, due to the low number of fatalities ([?] with permission).

Fig. 3. Method survival in CAPD and HD patients. For HD, the 'internal' drop-out (from diffusive to convective or mixed dialysis) was also evaluated.
and New Zealand. PD is now the most frequently prescribed chronic dialysis modality for children in many other parts of the world as well [8]. In Italy more than 70% of PD children are presently on APD [9].

As stated before, home PD is a good choice for adults having access to a good transplantation programme. For those who do not, and also for patients with contraindication to a graft, the first choice is probably bicarbonate HD with biocompatible membranes. However, they too may prefer home dialysis, and in this case, besides home HD, either CAPD or APD are good options, once it is accepted that maintenance on CAPD is on average lower than on HD, and the retention on APD still remains to be ascertained. A strong preference for home dialysis reduces the probability of change of method since, as noted above, patient/partner choice has become the most important reason for method drop-out.

In the elderly, life expectancy in dialysis patients is much reduced. In our region, life expectancy is 4.2 years for men and 4.5 for women aged 65–69, 2.9 and 3.6 for 70–74, 2.7 and 2.7 for 75–80 and 2.4 and 1.4 for 80–84 years old, respectively (Lombardy Registry for Dialysis and Transplantation, unpublished data).

Thus, the prevalent aspect is patient survival. This is not different on CAPD and HD in the long term and is better on CAPD in the first 2 years in patients ≥ 75, for whom drop-out is not different in the two methods. As those ≥ 75 years old are often affected by cardiac disease and other co-morbidity, CAPD or APD, with better cardiovascular tolerance, are probably the best dialysis method.

Co-morbidity and method choice

Many factors are in favour of better cardiovascular tolerance on PD than on HD, and this can be critical in cardiopathic patients or in elderly patients with severe cardiovascular senescence. In particular, the lack of arterovenous fistula, the better control of anaemia, and the stability of electrolyte and acid–base status are important. Even more important are the dialysis effects on diastolic function. In fact, on HD, in the interdialytic period there is risk of ECV expansion, with atrial and pulmonary congestion and arrhythmia, and during the dialysis session there is risk of excessive UF, with ECV contraction and reduced refilling, which can lead to collapse and sudden death [10]. All these effects are minimized on PD, as there is continuous dialysis and ultrafiltration with substantially stable ECV. However, PD is more atherogenic and may predispose to the progression of peripheral vasculopathy [11].

CAPD has some advantages over HD for diabetics: no need for vascular access, steady biochemical state, and easy control of hypertension and ECV. It avoids haemodynamic alterations, mostly useful for patients with autonomic nervous system dysfunction, coronary artery disease, peripheral vasculopathy and retinopa-

Rehabilitation and quality of life

This topic has been recently reviewed by Wolcott and Nissenson [17] and Gokal [18]. Quality of life is assessed on subjective measurements (life satisfaction, well-being, psychological affect), objective measurements, sexual and psychosexual problems and employability. Subjectively, transplanted patients perceive their quality of life as better than that on dialysis. For dialysis patients, surprisingly, the quality of life is perceived as little different from that in the normal population. Home patients may have a better quality of life than patients on in-centre HD (ICHD).

In objective measurements there is evidence of successful rehabilitation only in transplanted and in some home dialysis patients. Functional status and mobility appear to be worse on HD and CAPD, but there are controversial results, and it is not easy to understand whether quality of life is better on ICHD or on CAPD. Sexual and psychosexual problems are more common in dialysis compared to transplant patients. Employability has been found to be much better in transplanted than in dialysis patients, and better in CAPD than in ICHD patients.

Although studies on quality of life and rehabilitation have failed to demonstrate differences between CAPD and HD, the increasing CAPD drop-out over time, in the longest follow-up, seems to indicate that, with the disappearance of residual renal function, when more than 4 bags a day or more dialysate volume is needed, some patients perceive their quality of life as worse on PD than on HD, and ask to change method.

Malnutrition

Malnutrition is an important problem in dialysis, as it might influence patient survival. Malnutrition is usually
assessed by subjective global assessment, as proposed by Detsky et al. [19], based on weight change in the last 6 months, changes in dietary intake from normal, appearance of persistent gastrointestinal symptoms, Karnofsky scale of activity, nutritional requirements and subjective evaluation of fat loss, muscle wasting and presence of oedema or ascites.

The Italian cross-sectional study on malnutrition included our patients and those of seven other Italian centres [20]. Nutritional status was evaluated in 224 patients on CAPD and 263 on HD with the subjective global assessment. The percentage of well-nourished patients was not different on CAPD and HD but on CAPD there were more severely malnourished patients than on HD.

In our patients taking part in this cross-sectional study we evaluated the effect of nutritional and adequacy parameters in a prospective study lasting 3 years [21]. Factors influencing survival on CAPD and HD were studied with the Cox hazards regression model. Age, peripheral vasculopathy, \( Kt/V < 1.7/\text{week} \) on CAPD or \( Kt/V < 1.0/\text{treatment} \) on HD, and RRF all were significantly correlated. On the contrary, SGA, as well as gender, modality, 'age \times modality', treatment period, and other co-morbid conditions, were not significantly correlated. On CAPD serum albumin <3.5 g/dl and nPCR <1 did not significantly influence survival after adjusting for age and co-morbidity. Thus, whereas adequacy parameters affected survival, nutritional parameters did not. For a patient aged 60 years (mean age of our patients) and without co-morbidity, 3 years survival is very high, without any difference between malnourished and well-nourished at SGA. This shows that in standard dialysis conditions malnutrition is not severe enough to affect survival, although at the start of the study 24% of CAPD patients had <3.5 g/dl serum albumin, 34% had nPCR <1.0 and 41% were classified as malnourished at SGA. It is quite possible that the influence of malnutrition on survival emerges only with patients put on dialysis in worse nutritional conditions or less adequately dialysed.

Adequacy of dialysis

Contrary to nutritional parameters, the effect of adequacy parameters on survival is remarkable [21, 22]. On HD, we obtained the best survival with \( 1.0 < Kt/V < 1.2/\text{treatment} \). On CAPD, dividing patients into three groups with different \( Kt/V \) we saw no significant difference after the first year in observed and adjusted survivals, for patients with weekly \( Kt/V < 1.7 \) and between 1.7 and 1.96, whereas for \( Kt/V \geq 1.96 \), survivals were significantly greater. This indicates that a larger dialysis dose than that usually recommended is desirable to obtain better survival. It also suggests that the link between dialysis inadequacy and malnutrition, if any, is quite loose, as in our patients there is no correlation between malnutrition indices (serum albumin, nPCR, SGA) and mortality.

Conclusion

In summary, transplantation is by far the best renal replacement option and its availability also influences the selection of dialysis method. In this choice, more attention should be given to medical than non-medical factors, and more freedom should be left to the patient, after in-depth information.

Convective and mixed HD treatments seem to be better tolerated than diffusive HD, but are expensive, so their application is presently very limited. Where they are applied, the internal drop-out from diffusive to mixed HD techniques makes lower the drop-out from HD to CAPD.

HD and PD assure similar survival but, due to different drop-out, retention in the method is higher on HD, except for old patients. Age and co-morbidity are important determinants of the choice of the method. After adjusting for selection bias, the effect on survival of differences in malnutrition, as assessed by serum albumin level, nPCR and SGA, are not evident after a 3 year follow-up. On the contrary, dialysis dose significantly affects survival and \( 1.0 < Kt/V < 1.2/\text{treatment} \) on HD and a \( Kt(p+r)/ V > 1.96/\text{week} \) on CAPD appear to be the adequate dialysis doses.

References

13. Maiorca R, Vonesh EF, Cavalli PL et al. A multicenter selection-
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