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Home dialysis and physical activity: state of knowledge and recommendations for the nephrologist

(Dialyse à domicile et activité physique : état des connaissances et recommandations pour le néphrologue)

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Summary

Home-Dialysis promotes the autonomy of dialysis patients, and should be accompanied by a higher level of physical activity and physical capacity than conventional hemodialysis. There are no data on daily-home-hemodialysis patients, but peritoneal dialysis patients have similar levels of physical activity and physical capacity to conventional hemodialysis patients. There are no studies evaluating the effect of a re-training program in daily-home-hemodialysis patients. Several studies have demonstrated the feasibility and safety of re-training programs in peritoneal dialysis patients, with beneficial effects on quality of life and physical capacity. Regular physical activity of 30 minutes, 5 times a week, is recommended for dialysis patients. All periods of low- to moderate-intensity physical activity should be taken into account when calculating the 30 minutes, and it is therefore possible to include physical activity as part of daily life, physical exercise and leisure sports activities. It is the role of nephrologists to promote the practice of regular physical activity to their patients, possibly with the support of physical activity professionals whose role will be to assess patients' physical condition, motivation and lifestyle, design individualized physical rehabilitation programs for each patient, supervise these programs and empower patients towards a more active lifestyle and regular physical activity. The lack of studies should not be a hindrance to nephrologists, who can draw on existing recommendations from cardiology and International Society for Peritoneal Dialysis (ISPD).

Keywords: Peritoneal dialysis, hemodialyisis, physical activity, sport

Résumé

La DAD favorise l'autonomie des patients dialysés et devrait s'accompagner, chez ces patients, d'un niveau d'activité physique et de capacités physiques plus élevés qu'en hémodialyse conventionnelle. Il n'existe pas de données concernant les patients en HDQ et chez les patients en DP, on constate un niveau d'activité physique et des capacités physiques similaires aux patients en HD conventionnelle. Il n'existe pas d'étude évaluant l'effet d'un programme de réentrainement chez les patients en HDQ. Plusieurs études ont montré la faisabilité et la sécurité de programmes de réentrainement chez les patients en DP avec des effets bénéfiques sur la qualité de vie et les capacités physiques. La pratique régulière d'une activité physique (AP), 30 minutes, 5 fois par semaine, est recommandée pour les patients dialysés. Toutes les périodes d'AP d'intensité faible à modérée doivent être prises en compte dans le calcul des 30 minutes et il est ainsi possible/souhaitable d'intégrer les AP de la vie quotidienne, les exercices physiques, et les activités sportives de loisirs. C'est le rôle des néphrologues de promouvoir la pratique d'une activité physique régulière envers leurs patients en s'appuyant éventuellement sur des professionnels de l'AP. Il sera de leur compétence d'évaluer la condition physique des patients, leur motivation et en fonction de leur mode de vie, de concevoir des programmes de réhabilitation physique, individualisés pour chaque patient. Ces professionnels superviseront les programmes et autonomiseront les patients vers un mode de vie plus actif par une activité physique régulière. Le manque d'étude ne doit pas être un frein pour les néphrologues qui pourront s'appuyer sur des recommandations existantes issues de cardiologie.

Mots-clés : Dialyse péritonéale, hémodialyse, activité physique, sport

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Introduction

In dialysis patients, the benefits of physical activity (PA) on health status are multiple and well-demonstrated, such as improved quality of life and cardiovascular comorbidities [1-5]. In 2020, the European Society of Cardiology updated its recommendations on the practice of sport in patients with cardiovascular disease to include patients with chronic kidney disease [6,7]. New recommendations have recently been issued by the learned societies of nephrology concerning the practice of PA for haemodialysis and peritoneal dialysis patients [8-12]. In spite of this, the practice of physical activity is underdeveloped among dialysis patients [13]. Numerous obstacles to PA have been identified, such as the burden of illness, chronic fatigue, dialysis sessions, numerous associated comorbidities and fear of injury [14, 15]. Obstacles also exist among doctors who, although they are now aware of the beneficial effects of PA, do not promote physical activity among their patients due to lack of time, lack of knowledge, or fear of the risks associated with PA [16].

Home dialysis techniques, such as peritoneal dialysis (PD) and daily home hemodialysis (DHH), offer patients a better quality of life, with extrarenal purification methods that are more physiological, less time-consuming and better integrated into daily life, reducing fatigue and restoring patients' autonomy and free time [17,18]. Home dialysis would thus reduce sedentary lifestyles and increase the level of physical activity, ultimately improving the physical condition of dialysis patients. In a retrospective longitudinal observational study comparing 19129 in-center-HD patients with 886 Home dialysis patients (PD=825 and DHH n=61), Eneanya et al. used a propensity score that took into account gender, age, ethnicity, albumin, number of comorbidities and residual renal function to show a statistically significant difference in physical score at dialysis initiation, as assessed by the SF36, in favor of home dialysis patients (41.1 ± 10.5 VS 38 ± 10.3 $p<0.01$). The latter persisted over time for home dialysis patients, but decreased when patients were transferred into a center [19]. Nevertheless, there are few studies in the literature on this subject. With regard to hemodialysis, the majority of studies focus on conventional hemodialysis patients dialyzed three times a week [20-24]. And in peritoneal dialysis patients, the presence of dialysate in the peritoneal cavity was often considered a limitation to the practice of many physical activities [25].

The aim of this article is firstly to describe the main findings on PA and home dialysis, and secondly to provide a reminder of the definition of PA and how to implement it, so that nephrologists can promote PA in home dialysis patients.

Daily home hemodialysis and physical activity

Daily hemodialysis (DHH) has undergone a revival over the last ten years, with the arrival of new, simplified dialysis machines enabling patients to carry out independent 2h-2h30 dialysis sessions at home, typically 5 to 7 days a week [26]. Among dialysis patients, DHH patients are usually those with the best health status. In 2021, in the REIN registry, 49% of them had no comorbidities, compared with 22% of all dialysis patients [27]. This suggests that these patients are in better physical condition, with less sedentary lifestyles and higher levels of physical activity. To our knowledge, there are no data in the literature specifically analyzing the physical activity levels and physical capacities of these patients. A prospective study is currently underway to assess the physical activity level of patients in DHH vs. in-center hemodialysis

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using a pedometer [28]. On the other hand, several studies have assessed the quality of life of DHH patients. The Frequent Hemodialysis Network (FHN) Daily Trial showed that DHH patients had an average 3.3-point improvement in a composite physical activity score assessed by the RAND 36 questionnaire, compared with an average 0.2-point improvement for conventional HD patients [29]. This is the only randomized study to compare patients on conventional HD (3 sessions per week) with patients on DHH (6 sessions per week). The study was carried out in North America, with 120 patients in each group. The FREEDOM study assessed the quality of life of DHH patients using the SF36 score [30]. This was a prospective multicenter observational study carried out in the USA, involving 291 patients. At 4 and 12 months, the remaining 217 and 154 patients respectively showed a significant improvement of 3 and 4 points respectively in the SF36 physical score compared with the initial assessment. This improvement concerned all 6 domains assessed by the SF36 physical score.

Peritoneal dialysis and Physical activity (PA)

While peritoneal dialysis (PD) provides patients with greater autonomy than conventional HD, the studies found no difference in patients' physical activity levels or physical capacity between these two renal replacement therapy groups. In a systematic review published in 2013, grouping together 46 studies published between 1985 and 2011, and comparing the three renal replacement modalities (transplantation, HD and PD) Purnel et al. showed that there was no difference between HD and PD patients regarding physical activity levels [31]. More recently, Painter et al. compared the physical capacity assessed by a battery of physical tests (gait speed, chair stand, standing balance, 6-minute-walk, incremental shuttle walk) and the SF36 questionnaire, and the level of physical activity assessed by a CHAMPS (Community Healthy Activities Model Program for Seniors) self-questionnaire in two groups of 45 HD and PD patients, matched on age, sex and diabetes [32]. The patients in both groups had the same level of physical activity and physical capacity, which were also low for their age (mean age 49 in each group) and corresponded to the levels of patients aged 70. This lack of difference in physical fitness between PD and conventional HD patients, observed in the studies, could be explained by greater heterogeneity in the health status of PD patients compared with DHH patients. Again according to REIN registry data, of all prevalent PD patients in 2021, 39.4% had no comorbidities, 24.8% had 1 comorbidity and 40.3 had at least two comorbidities [27].

Studies evaluating the effect of a PA program in PD patients are few and small. A meta-analysis was published in 2018 on this subject [33]. It identified 6 observational and 6 interventional studies with numbers ranging from 3 to 64 patients. The observational studies had assessed physical activity levels either by pedometer (n=4) or questionnaire (n=2). Interventional studies evaluated either an aerobic (n=3) or anaerobic (n=1) protocol, or the effect of Tai Chi (n=1). One study showed an improvement in peak VO2. In none of these studies was there any adverse effect of PA in relation to PD. Similarly, Isnard Rouchon et al. showed that it was possible to offer PD patients high-intensity interval training protocols on ergocycles twice a week without risk to the patients [34]. Recently, Uchiyama et al carried out a randomized trial in PD patients, evaluating over 12 weeks the effect of a mixed aerobic and anaerobic rehabilitation protocol carried out at home in autonomy compared with standard care [35]. Patients were initially trained in the protocols by physical activity instructors, and received weekly postcards to assess exercise adherence. Aerobic sessions included 3 walking sessions per week of moderate intensity (Borg 11-13) corresponding to a heart rate of 40-60% of peak HR, for an effort duration of 20 min

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initially with the instruction to gradually increase to 30 minutes. The anaerobic sessions included series of 10 repetitions of muscle strengthening of different muscle groups with an elastic band, twice a week at an intensity of 70% of a maximum repetition (MR). The authors of this study found a significant improvement in quality of life and all its components as assessed by the Kidney Disease Quality of Life-Short Form questionnaire, and no adverse effects were observed. Adherence to the program was good, estimated at 52% for aerobic exercise and 76% for muscle strengthening. These studies confirm the safety and beneficial effects of PA programs in PD patients.

To promote the regular practice of PA among dialysis patients, we must first overcome the medical obstacles, which are lack of time, lack of knowledge and fear of the risks associated with PA [16]. These three obstacles are in fact linked and are based on a lack of knowledge among nephrologists concerning the definition and implementation of PA. In the second part of this article, we propose a simplification of these notions.

Definitions and recommendations

Physical activity is defined as any bodily movement produced by skeletal muscles, resulting in energy expenditure greater than that of the resting metabolism [36]. Physical activity includes the physical activities of daily living, physical exercise and sporting activities [37]. Physical fitness is the general capacity to adapt and respond favorably to physical effort. It has several dimensions: 1) cardio-respiratory capacity, also known as endurance, 2) muscular capacities or aptitudes, which include muscular strength, muscular endurance and muscular power, 3) musculo-tendinous and articular flexibility, 4) neuromuscular capacities or performances such as balance, speed and muscular coordination or agility, and finally 5) anthropometric components (weight, height, percentage of fat mass with body mass index and abdominal perimeter). Physical activities have different energy costs and can be classified into 5 main categories according to their intensity [38]: sedentary, low intensity, moderate intensity, high intensity, very high intensity. A simple way of assessing the intensity of an effort is to use sensation scales such as the modified BORG visual scale, which describes the level of respiratory discomfort during an effort by rating it from 1 to 10 [39]. Each physical activity modality can be quantified using the FITT criteria, which describe for each type of physical activity its frequency («F» or number of sessions per week), intensity («I» from low to intense), type («T» such as endurance, muscle strengthening, etc.), and practice time («T» or time during which PA is practiced) [40]. We thus define a volume of physical activity (or quantity of PA) which is calculated by multiplying the duration of PA by its intensity, the duration of PA corresponding to the time of PA sessions multiplied by their frequency.

It is recommended (see *Table I*) to achieve a volume of 150 minutes per week of moderate-intensity PA (spread over three to five sessions per week), i.e. a total energy expenditure ≥ 500 - 1000 MET-min per week [41]. This should be combined with muscle strengthening (two non-consecutive sessions per week) and flexibility and balance exercises, particularly in the elderly. All periods of PA of at least moderate intensity should be taken into account when calculating the recommended 30 minutes of daily PA. It is therefore possible to incorporate all forms of PA into daily life, such as daily activities (walking, cycling, stair climbing), physical exercise and leisure sports [42]. Even low-intensity PA is beneficial to the health of sedentary patients. Beyond 300 min per week of moderate-intensity PA, the additional benefits become limited, while the risks increase.

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Table I. Recommendations for PA levels [41]

Aerobic exercise

At least 30 minutes a day of moderate-to-intense cardiorespiratory exercise:

-At least 5 days a week (additional benefits if 45 to 60 minutes)

-If possible, every day.

-Beneficial from the very first minute

-May be an accumulation of various types of PA

-Avoid inactivity for 2 consecutive days

Muscle-strengthening exercises

-In everyday life and/or during a dedicated PA

-1 to 2 times a week with 1 to 2 days recovery time between 2 sessions

-8 to 10 different exercises involving upper and lower limbs, 2 to 3 sets of 10 to 15 repetitions

-To be adapted to individual characteristics

Aerobic and muscle-strengthening exercises can be integrated into the same PA.

Flexibility and joint mobility exercises

At least 2 to 3 times a week (after a muscle warm-up)

-Stretches held for 10 to 30 seconds, repeated 2 to 3 times

-Stretching should be limited by the sensation of discomfort or stiffness

Remarks

-All recommendations are valid for people with pathology(ies) or disability(ies), on prior medical advice.

-Adjustments based on individual capabilities, risks or limitations (coaching)

-Adjust to specific recommendations proposed by learned societies

For inactive and sedentary people

-Gradually increase PA levels: frequency, duration, then intensity

-To reach or get closer to the goal of the recommendations

-Choosing a pleasant AP

The recommendations concerning the volume of weekly PA to be achieved for dialysis patients are the same as those for the general population [43-46]. For certain patients, special precautions need to be implemented, taking into account associated comorbidities, advanced age and specificities linked to dialysis methods [6-12]. This is where physical activity specialists come in, as we shall see below. In *Table II* and *Table III*, you'll find the safety rules you need to teach your patients to practice PA safely, and to detect any signs of unstabilized cardiovascular pathology.

Physical activity risks

In the general population, the cardiovascular risk associated with the practice of leisure sports is very low, with an incidence of sudden death of 4.6 cases per million inhabitants [37]. The same applies to patients with renal failure, where the risks associated with PA have been evaluated and are exceptional [8-12, 43]. The risk of a CV or musculoarticular accident occurring during PA is linked, on the one hand, to the volume and intensity of the patient's usual physical activity, and on the other hand to the envisaged intensity of future PA [37, 40, 47]. Thus, the risk is proportionally

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Table II. General rules of good PA practice [37, 38]

1- Inactive and/or sedentary people should start with a low-intensity PA program and gradually increase in stages until they reach the recommended or desired level of PA.
2- Physically active people need to adapt their PA program to variations in their physical condition and environmental conditions.
3- People who take part in physical exercise must be taught to recognize warning signs and symptoms, and to report them to their doctor. These include chest pain, abnormal breathlessness, palpitation or malaise during or after exercise.
4- A 10-minute warm-up and cool-down are recommended.
5- We recommend hydrating with 3-4 sips of water every ½ hour.
6- Physical activity must be adapted to the patient's treatment (hypoglycemic, beta-blocker, antihypertensive vasodilator).

Table III. Rules for adapting PA for patients on treatment [38]

PATIENTS ON BETA-BLOCKERS MAY PRESENT :
-a reduction in physical capacity, and it is preferable to modulate exercise on the basis of a physical sensation scale
-hypoglycemia when exercising in hot, humid conditions, in which case it is advisable to reduce the intensity and duration of exercise
PATIENTS ON VASODILATOR ANTIHYPERTENSION TREATMENT are at risk of arterial hypotension after exercise and should extend the recovery period by a few minutes
PATIENTS AT RISK OF HYPOGLYCEMIA should monitor their blood sugar levels before and after their training program, and have quick-sugar snacks available in case of hypoglycemia

higher in the most sedentary individuals when they engage in unusual and infrequent moderate- or high-intensity PA. The risk of serious CV events during PA is mainly related to its intensity, less to its frequency or duration. The patient's CV history and risk level should also be taken into account. In the vast majority of cases, the accident reveals an unrecognized CV pathology [37, 38, 40, 47]. Any asymptomatic, medically-controlled patient can engage in low-intensity PA. The rules for assessing patients before starting physical activity are summarized in *Table IV*.

Table IV. Medical assessment of patients prior to PA practice [37, 40, 47]

1- Any patient who is symptomatic and/or not medically stabilized is not suitable for physical exercise, and should first be evaluated by a specialist (nephrologist, cardiologist, sports physician, etc.).
2- Don't overestimate the risk of physical activity. The health benefits of regular exercise are indisputable, and far outweigh the cardiovascular risks.
3- We need to estimate the intensity of the planned exercise and assess the patient's usual level of exercise.
4- The patient's CV history and CV risk level must be assessed.
5- All asymptomatic patients can start light-intensity PA
6- A cardiological assessment is recommended for inactive patients with a high SVR and/or a history of CV disease who wish to practice moderate-intensity PA, and for all patients wishing to start high-intensity PA.

How to implement the Physical activity

[43, 44, 48] Once nephrologists are convinced of the benefits of PA, which no longer need to be

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demonstrated, all they have to do is promote PA among their patients and, ideally, refer them to PA professionals. These PA professionals, known in France as "enseignants en activité physique adaptée" (EAPA), will be responsible for 1) assessing patients' physical condition, motivation and lifestyle, 2) designing individualized physical rehabilitation programs for each patient on the basis of the initial patient assessment and the recommendations of learned societies in sports medicine, 3) supervising these programs and 4) empowering patients to adopt a more active lifestyle and regular physical activity. The participation of physical activity professionals in these programs is a key element in their success, as shown by P Bennett et al. in a feasibility study which offered PD patients to take part in a 12-week physical rehabilitation program combining individualized aerobic and anaerobic exercise according to the American College of Sports Medicine guidelines [49]. After an initial assessment, these EAPAs offered each patient personalized exercises with a progressive increase in effort over several sessions, while promoting autonomy and encouraging a more active lifestyle.

Adapted physical activity (APA) is a physical practice adapted to the pathology, physical capacities and medical risk of patients [50]. It is considered to be a non-medicinal therapy whose objectives are health benefits, quality of life, identity reconstruction and social participation, with a fun and well-being dimension. The aim is to bring about a change in sedentary behavior towards a more active lifestyle, and for this change to be sustained over time. APA should not be seen as sport to improve health, as the demands of sport, and the notions of performance and surpassing oneself, are seen as an obstacle and/or a danger for these fragile patients, whether by the patients themselves or their doctors. Finally, APA must not be a burden that adds to the burden of the disease. Patients' motivations for practising physical activity can vary widely, depending on whether they see it as a way of treating their illness and its side-effects, a way of keeping healthy, a way of life and socializing, a way of taking care of themselves in order to rebuild their lives, a way of enjoying their bodies, or conversely, as a moral obligation towards healthcare professionals.

In conclusion

HOME-DIALYSIS promotes the autonomy of dialysis patients, and should be accompanied by a higher level of physical activity and physical capacity than conventional hemodialysis. There are no data on DHH patients, but PD patients have similar levels of physical activity and physical capacity to conventional HD patients. There are no studies evaluating the effect of a re-training program in DHH patients. Several studies have demonstrated the feasibility and safety of re-training programs in PD patients, with beneficial effects on quality of life and physical capacity. Regular physical activity of 30 minutes, 5 times a week, is recommended for dialysis patients. All periods of low- to moderate-intensity PA should be taken into account when calculating the 30 minutes, and it is therefore possible to include PA as part of daily life, physical exercise and leisure sports activities. It is the role of nephrologists to promote the practice of regular physical activity to their patients, possibly with the support of PA professionals whose role will be to assess patients' physical condition, motivation and lifestyle, design individualized physical rehabilitation programs for each patient, supervise these programs and empower patients towards a more active lifestyle and regular physical activity. The lack of studies should not be a hindrance to nephrologists, who can draw on existing recommendations from cardiology.

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