

Bulletin de la Dialyse à Domicile

Feedback on the benefits of remote patient monitoring in Automated Peritoneal Dialysis in a French peritoneal dialysis center

(Retour d'expérience, dans un centre français, sur les bénéfices de la télémédecine en Dialyse Péritonéale Automatisée)

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Résumé

L'épidémie COVID-19 a souligné la place croissante de la télémédecine pour les traitements par dialyse à domicile. Depuis l'apparition d'une machine de dialyse péritonéale automatisée (DPA) connectée (machine Claria Share Source Baxter®), nous avons systématiquement proposé cette solution à nos patients traités par DPA.

Au cours des deux dernières années, nous avons traité 35 patients sous DPA connectée, dont 20 sont toujours sous la technique (âgés de 50 à 87 ans) et représentent 54% des patients en Dialyse péritonéale. Un questionnaire sur 5 sujets (Passage à la machine connectée, le stress, la sécurité, le quotidien et les vacances) leur a également été remis et a mis en évidence que 80 % des patients n'avaient aucun stress lié à la télésurveillance, tandis que 18 patients sur 20 (90 %) se sentaient en sécurité.

Au cours de l'année 2020, nous avons reçu 74 appels téléphoniques dans le cadre des astreintes téléphoniques, dont 42 appels pour les 20 patients en DPA connectée, 1 chez un patient en DPA normal et 32 appels chez 16 patients en DPCA. Les erreurs de manipulation ont concerné 42,85% des appels, les erreurs système ont concerné 4,76% des appels, la validation du programme 7,14% des appels, et les problèmes de connexions ont concerné 9,52% des appels.

Nous avons ainsi pu corriger plusieurs problèmes à distance : problèmes de drainage, prises de poids, déséquilibre tensionnel, mauvaise observance, problèmes de connexion.

Grâce à la plateforme, nous sommes averties quotidiennement d'un éventuel problème. Cela amène un gain de temps pour les infirmières en terme d'organisation pour gérer d'autres problèmes. Notre façon d'éduquer les patients et infirmiers libéraux n'a pas changé. En effet, seule une connexion au réseau ainsi que la saisie du poids et de la tension ont été ajoutées, et les consommables sont restés identiques.

De nuit comme de jour, ou en période de crise sanitaire, nous pouvons apporter une réponse rapide et ciblée au questionnement du patient grâce à la plateforme.

Summary

The COVID-19 pandemic has highlighted the growing role of telemedicine in home dialysis treatments. Since the appearance of a connected automated peritoneal dialysis (APD) machine (Claria Sharesource Baxter® machine), we have systematically offered this solution to our patients treated with APD. Over the past two years, we have treated 35 patients with connected APD, of which 20 are still under the technique (aged 50 to 87) and represent 54% of the patients on peritoneal dialysis.

A questionnaire on five subjects (perception of switching to the connected machine, stress, safety, everyday life, and vacations) was also given to them and showed that 80% of the patients had no stress related to the telemonitoring, while 18 out of 20 patients (90%) felt safe.

In 2020, we received 74 phone calls during on-call phone duty, including 42 calls for the 20 patients on connected APD, one all for a patient on normal APD, and 32 calls for 16 patients on continuous ambulatory peritoneal dialysis (CAPD). Handling errors concerned 42.85% of the calls, system errors concerned 4.76%, program validation concerned 7.14%, and connection problems concerned 9.52%. We were thus able to correct several problems remotely, such as drainage problems, weight gain, blood pressure imbalance, poor compliance, and connection problems.

Thanks to the platform, we are notified daily of a possible problem. This saves the nurses time and allows them to deal with other issues. The way we educate patients and assist private nurses has not changed. Indeed, only the connection to the network as well as the entry of the weight and arterial pressure were added, and the disposables remained the same.

Night or day, or in times of a health crisis, we can provide a rapid and targeted response to the patients' questions, thanks to the platform.

Mots clés : Dialyse péritonéale automatisée, Dialyse péritonéale continue ambulatoire, télémédecine, Ultrafiltration, Test d'équilibre péritonéale, pression intra péritonéale

Key words : automated peritoneal dialysis, continuous ambulatory peritoneal dialysis, telemedicine, ultrafiltration, peritoneal equilibration test, intraperitoneal pressure

INTRODUCTION

Remote monitoring of dialysis patients has been developing in recent years, and peritoneal dialysis connected machines have appeared.

For more than two years, nurses in peritoneal dialysis (PD) units at AIDER SANTE have been using an automated peritoneal dialysis machine connected via a modem, allowing daily monitoring of their patients by remote monitoring. This is our first experience with remote monitoring of PD patients. We know that other systems exist, but at the moment, they are not used in our center.

Recent studies carried out in the United States [1] and in France [2] have demonstrated the benefits of such a tool for the patients and the teams. Its use has now spread to several European countries, such as England, Switzerland, Italy, and France [3].

We report here our experience on the management of problems that may arise in patients' homes, particularly during the COVID-19 pandemic and during our on-call telephone calls, which we have been providing since November 2019.

We also report the results of a survey of patients treated with connected automated peritoneal dialysis (APD).

PATIENTS AND METHODS

The use of remote monitoring in APD makes it possible to carry out daily monitoring and to detect the slightest problem during night treatment. Monitoring only takes a few minutes each day. Thus, daily monitoring of weight, blood pressure, ultrafiltration, and patient compliance can be remotely performed.

Twenty patients treated with modem-connected APD were included in the study. The connection was made by modem to a platform for hosting medical data and allowing remote control of the machine: the Claria Baxter® machine and the Sharesource® platform. The description and mode of operation had been described previously [2, 3].

The nursing and medical team can connect daily to the Sharesource platform to check if the night session is going well.

From August 2018, in agreement with the medical team and after training the nursing team on the use of the Sharesource platform, 20 out of 24 patients with a Baxter cyclor were transferred to a connected cyclor, three were transferred to CAPD, and one was transplanted. All patients had given their consent to subscribe to telemedicine.

To study the patients' profiles, we requested data extraction from the French Language Peritoneal Dialysis Registry (RDPLF). Each patient had given their consent for their inclusion in the RDPLF.

The only criterion retained for the transfer of patients to connected APD treatment was the infor-

med choice of each one because adherence to treatment is essential for its success.

The following questionnaire was sent to the 20 patients on connected APD and was structured around five questions. All the patients answered.

Question 1: How was your experience with the transfer from the Homechoice cyclor to the connected Claria cyclor?

Questions 2: Did it have a stressful effect? If yes, why?

Question 3: Has the connected CLARIA cyclor changed anything in your daily life?

Question 4: Do you feel more secure with the connected cyclor?

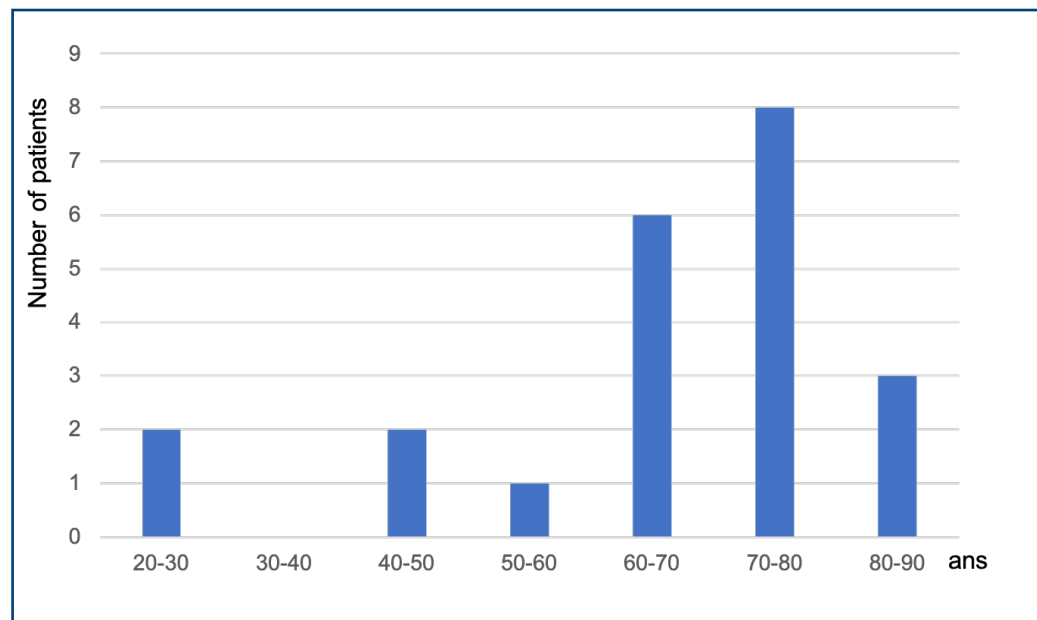
Question 5: Do you plan to go on vacation more often?

RESULTS

Of the 20 initial patients, 13 were still on a connected cyclor, two were transferred to HD, two were transplanted, one was transferred to CAPD, and two died. Since the deployment of the new connected cyclor, 15 new patients have been taken care of, but only seven have remained in the technique; two have been transferred to CAPD, three have been transferred to hemodialysis, one has been transplanted, and two have died.

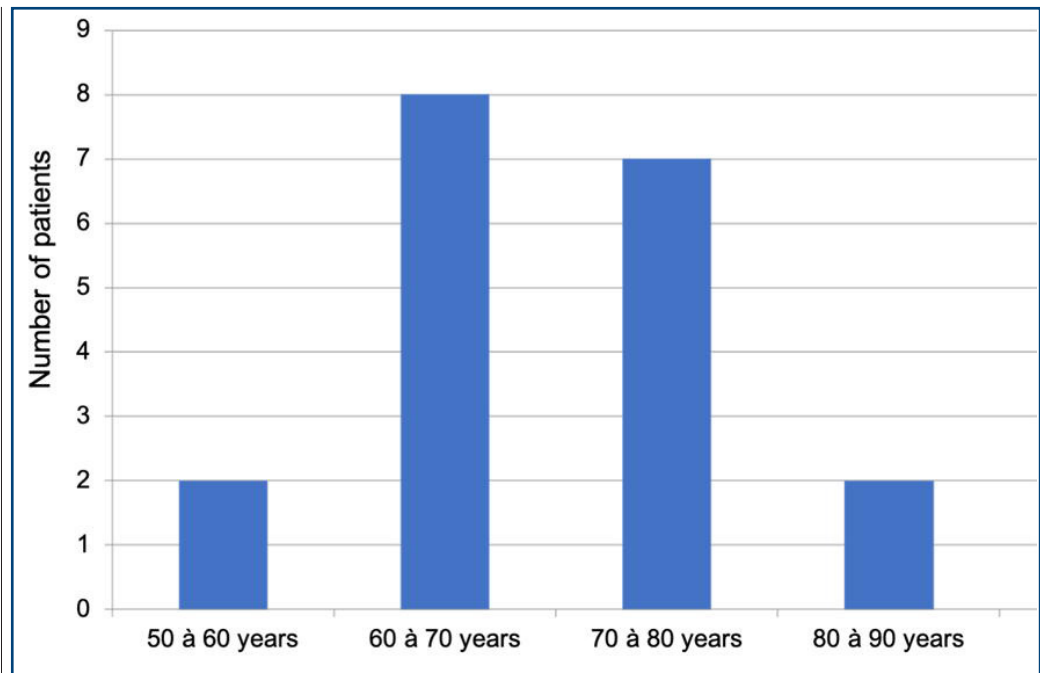
Patient profile

At the time of the deployment of the new connected cyclor, the profile of the patients was varied: they were between 20 and 90 years old (Fig. 1), 90.9% were autonomous, 69.23% were diabetic, and 36.36% were sedentary.



↑ Figure 1. Distribution of ages at the time of inclusion

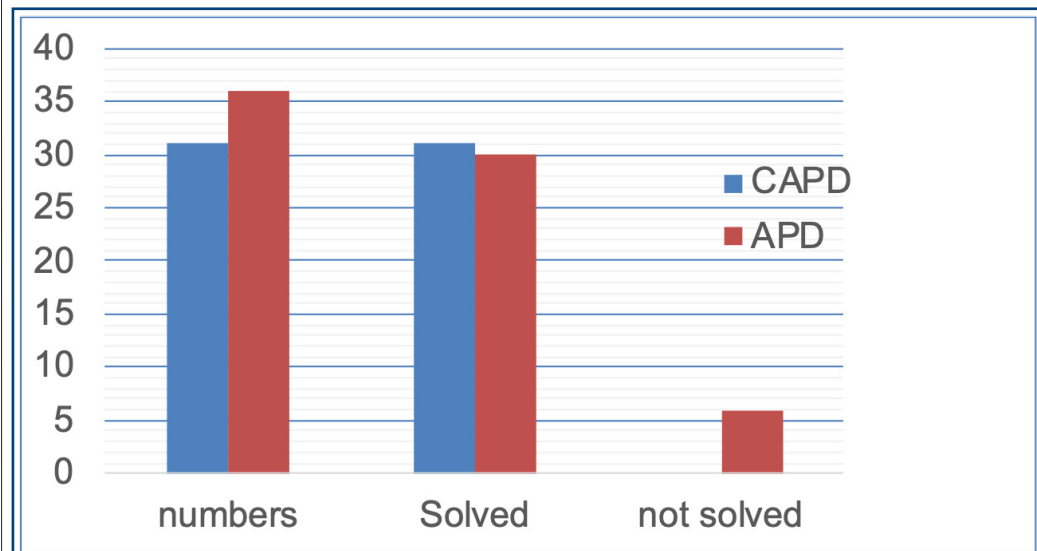
To date, out of 20 patients, 89.47% are independent in the technique, and 10.53% benefit from family or nurse assistance. They are aged between 50 and 87 years (Fig. 2), of which 52.63% are sedentary and 47.36% are diabetic.



↑ Figure 2. Distribution of ages of the patients currently treated

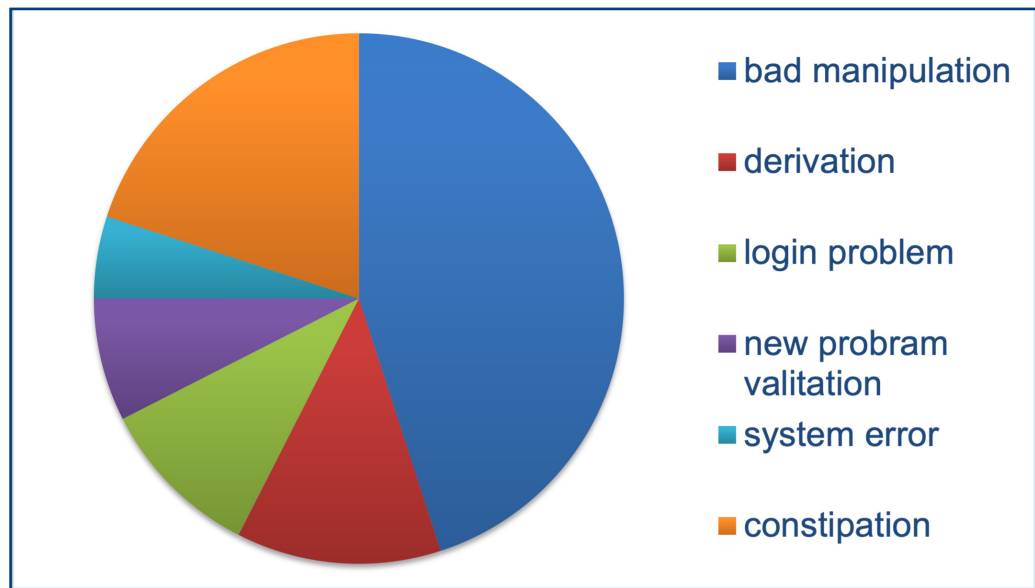
Management of on-call telephone calls

During 2020, we had 74 calls to our unit for 37 patients, of whom 20 are on connected APD and one under unconnected APD and 16 patients on CAPD (Fig. 3)



↑ Figure 3. On-call telephone calls in 2020

Since the start of nursing on-call duty in early November 2019, we have listed the problems encountered (Fig. 4) according to their occurrence over the year 2020.



↑ Figure 4. Distribution of reported problems during on-call telephone calls

Daily monitoring of nightly sessions can also detect other problems:

- Drainage problems: They concerned two patients suffering from chronic constipation, one with fibrin and catheter dysfunction.
- Weight gain: This concerned two patients with weight gain greater than 6 kg.
- Uncontrolled blood pressure: We had seen it in three patients, particularly those who had refractory hypertension (HTA). The doctor had to change the treatment regularly.
- Patient compliance: Thanks to graphical data, we see whether patients are carrying out their treatment or not.
- Connection problem: In 2020, we had two modems changed and an amplifier antenna installed in a patient living in a mountainous region.

Questionnaire results

The patient questionnaire revealed a variety of responses, not just targeted at telemedicine.

All patients who were transferred from the conventional cyclor to the connected one experienced it without a problem.

On the question about stress

- Seventeen patients enjoyed the introduction of the connected machine.
- Three patients were stressed because of three different reasons:
 - The noise the cyclor generates
 - Fear of poor network connection
 - The technique

On the question “What has the connected machine changed in your daily life?”

- Five patients responded that they were relieved to no longer have to record their dialysis information and write them in their monitoring book.
 - A patient sleeps less well because of the noise of the cyclor during the night.
 - Five patients felt better monitored.
 - For eight patients, telemedicine did not change anything for them.
- This generally shows confidence in the healthcare team.

On question 4 concerning the feeling of safety

- Eighteen patients felt safe, while it did not change anything for only two patients.

On question 5 about vacations

- Eight patients said they wanted to go on vacation and travel more often.
- Seven patients will not go on vacation more often because of their advanced age and the isolation of some of them.
- Four go on vacation using the double bag technique because it takes less space for them.
- A patient said he was very well at home.

DISCUSSION

The age profile changed between 2019 and 2020. In 2020, the population was older (Figs. 1 and 2) and more sedentary, but only 47.36% were diabetic compared with 69% in 2019. Those who previously would have chosen CAPD had more easily chosen connected APD because of the daily monitoring carried out by the medical team and the fact that it is reachable 24 hours a day.

Regarding the management of on-call telephone calls, out of the 74 calls in the Gard region, six could not be resolved (Fig. 3), most often because of the stress generated by the alarms and the late-hour calls (between midnight and 5:00 a.m.).

We also managed the on-call calls for Hérault patients (note: Hérault is a French area close to the center), which represented 132 calls for an average of 42 patients in 2020. Ninety calls concerned the connected and non-connected DPA, and 13 CAPD patients called us 42 times. In CAPD, mainly private nurses of assisted patients contacted us for drainage/injection and treatment problems.

The various problems encountered during our on-call duty and daily monitoring were listed according to their frequency.

• **Incorrect manipulations of the cyclor by the patient**

We found this problem during telephone calls. In particular, we encountered a problem with the handling of the cyclor (Fig. 5) during night treatment in three patients on several occasions. They had interrupted their treatment, believing that it was finished.

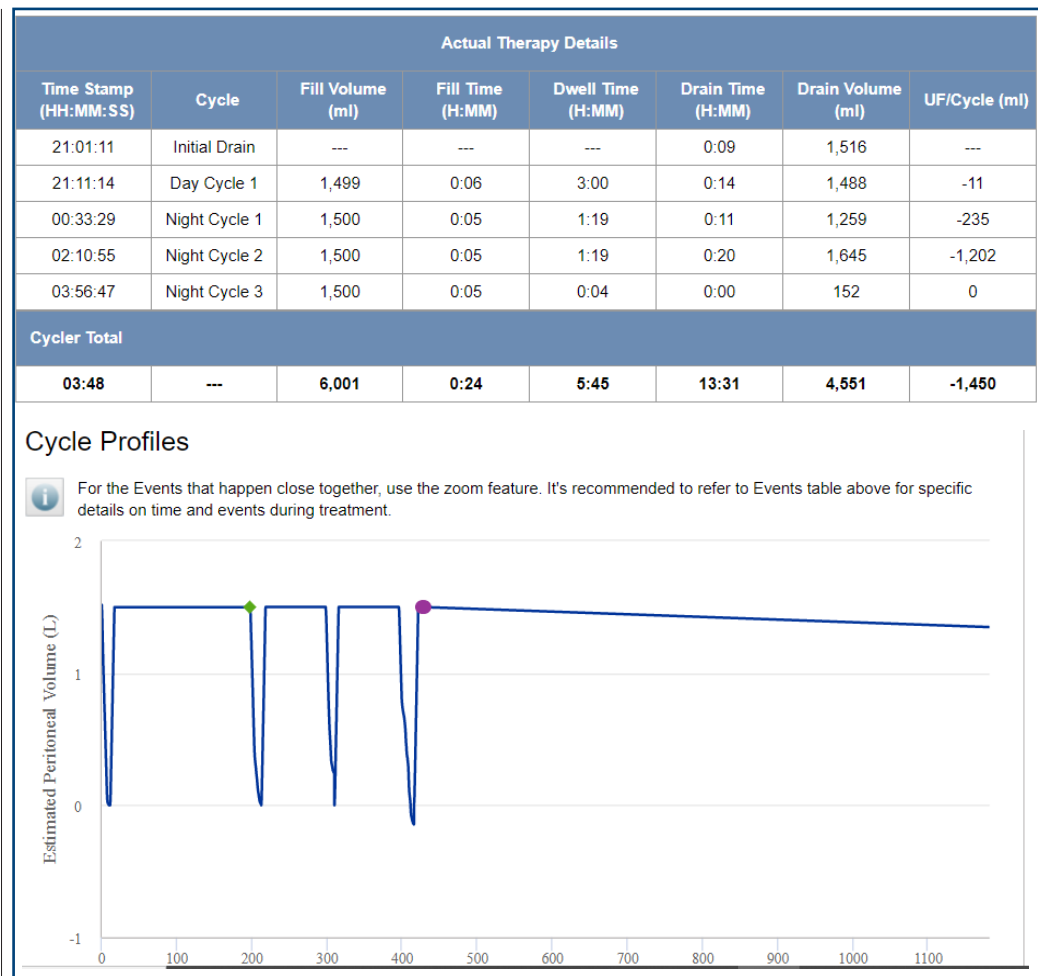


Figure 5. Representative graph of an interruption in dialysis

When the lines are poorly screwed during the preparation of the cycler or the lines have a defect, an air alarm (Fig. 6) can occur, causing the dialysis to be interrupted in 99% of cases. We encounter this problem at least once a month.

Time Stamp (HH:MM:SS)	Event Description
20:39:24	SYSTEM ERROR 2084 (2084)
20:42:10	SYSTEM ERROR 2265 (2265)

Figure 6. screen copy of air alarm

We observed that the assembly problems mainly arose during the first 15 days following installation, which led us to set up a monitoring of good practices three weeks after the installation of the patients to see that the assembly errors endure.

Educating patients on how to prepare their cycler as well as how to handle alarms is, therefore, essential during their learning period.

We also found assembly problems in certain patients who have been in their technique for several months and are on “automatic pilot”: they know how to do it but go too fast. This is why we carry

out a follow-up of good practices twice a year at home, where we carry out an evaluation of the practices of the patient and the private nurses if the latter is assisted, as well as a follow-up of the pharmacy stock. This home follow-up also enabled us to reduce the number of peritonitis (1 episode every 89 patient months at the end of December 2020).

• **Drainage problem**

Drainage problems characterized by an extended drainage time (Figs. 7 and 8) may occur in some patients. An “insufficient drainage” or “UF negative” alarm will then appear on the cyclor screen.

Actual Therapy Details							
Time Stamp (HH:MM:SS)	Cycle	Fill Volume (ml)	Fill Time (H:MM)	Dwell Time (H:MM)	Drain Time (H:MM)	Drain Volume (ml)	UF/Cycle (ml)
19:48:35	Initial Drain	---	---	---	0:20	2	---
20:09:04	Day Cycle 1	1,499	0:06	3:09	0:46	957	-542
00:11:59	Night Cycle 1	1,499	0:07	1:19	0:10	1,487	-11
01:49:54	Night Cycle 2	1,500	0:06	1:19	0:17	1,388	-111
03:33:29	Night Cycle 3	1,500	0:10	1:19	0:27	1,558	58
05:30:42	Night Cycle 4	1,501	0:11	1:19	0:35	1,379	-121
07:37:19	Night Cycle 5	1,499	0:11	1:19	0:36	1,487	-11
09:45:02	Last Fill	1,199	0:05	---	---	---	---
Cycler Total							
10:25	---	9,214	0:59	9:48	3:13	8,474	-739

Figure 7. Screen copy - Summary of a session

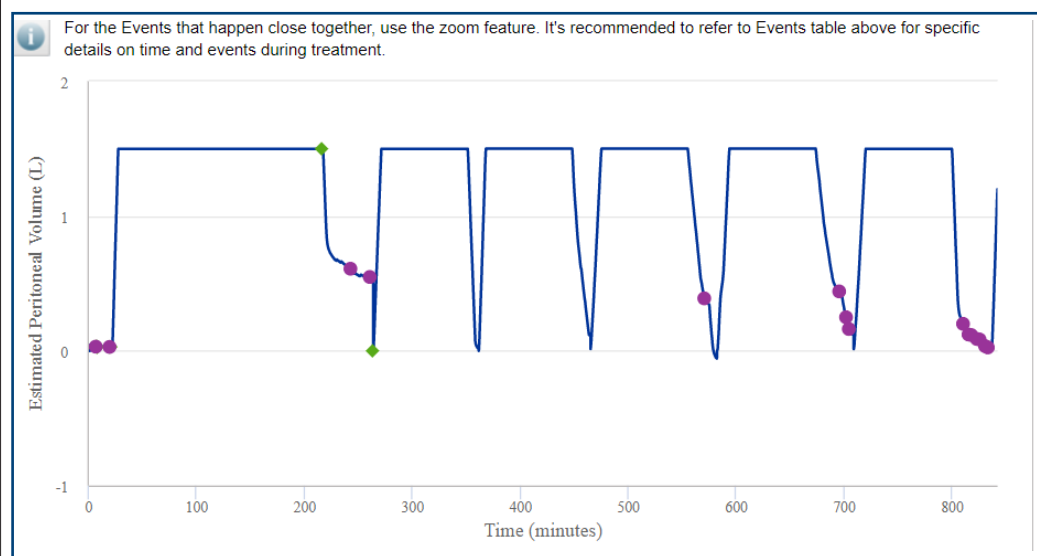



Figure 8. Screen copy - Summary representative graph of a session

Thanks to the graphical data, a distinction between the various problems can be made. We most often find a problem of constipation related to the patient’s old age, diabetic status, sedentary lifestyle, and taking of certain treatments.

Out of 20 patients, two suffered from chronic constipation which required the regular intake of a laxative: one patient took morphine daily and was sedentary, and the second was diabetic and did not adhere to the diet and was sedentary.

A longer drainage time of more than 20 minutes led us to a drainage problem linked to constipation (Figs. 9 and 10). The patients in question had indeed prolonged drainages for several days. After questioning them, it turned out that they had not had bowel movement for several days. A laxative prescription was, therefore, made by the nephrologist, which had a positive impact on the following drainages. In the event of incorrect positioning of the catheter or the presence of fibrin, the injection times are also lengthened (Fig. 9).

Actual Therapy Details							
Time Stamp (HH:MM:SS)	Cycle	Fill Volume (ml)	Fill Time (H:MM)	Dwell Time (H:MM)	Drain Time (H:MM)	Drain Volume (ml)	UF/Cycle (ml)
10:36:01	Initial Drain 	---	---	---	0:01	13	---
10:37:46	Night Cycle 1	1,999	0:59	• 2:00	1:02	1,829	-170
14:40:19	Night Cycle 2	2,000	0:10	0:22	0:32	2,071	71
15:45:38	Last Fill	1,899	0:09	---	---	---	---
Cycler Total							
05:19	---	4,116	1:19	2:22	1:37	4,017	-98

↑ Figure 9. Summary table of a session



We encountered the problem of fibrin in the dialysate in one patient (Fig. 10), which required several fibrinolyses.

↑ Figure 10. Presence of a fibrin plug molding the lumen of the catheter and expelled during a drainage phase. (photo sent by a patient)

If fibrin is present, we follow the peritoneal dialysis catheter fibrinolysis protocol in practice in our center.

Catheter malfunction was encountered, which required repositioning, which was not successful. The patient had to be transferred to hemodialysis. However, this problem is rare because we are fortunate to have two experienced operators for implanting catheters in the CHU CAREMEAU hospital in Nîmes.

• Weight gain

Weight gain can occur during peritoneal dialysis. Out of 20 patients, only two patients had significant weight gains (Fig. 11), greater than 6 kg. It was during the home visits that we realized that they were not capturing the actual weight, which made us question the patients' compliance with

entering the correct weight between two consultations.

During the training, each patient receives a small booklet explaining the complications in peritoneal dialysis (hydrosodic balance, peritonitis, infection of the emergence, mechanical complications, and line openings).

Treatment Date	Device Programme Name	Night Cycle UF (ml)	Total UF (ml)	Pre-Weight (kg)
14 Apr 2020	STANDARD	-107	207	77
15 Apr 2020	STANDARD	139	370	77
16 Apr 2020	STANDARD	46	229	77
17 Apr 2020	STANDARD	-468	-255	77
18 Apr 2020	STANDARD	57	522	77
19 Apr 2020	STANDARD	-246	87	77
20 Apr 2020	STANDARD	-133	224	77
21 Apr 2020	STANDARD	-337	-197	77
22 Apr 2020	STANDARD	-102	332	77
23 Apr 2020	STANDARD	1,147	1,368	83
24 Apr 2020	STANDARD	1,262	1,642	81
25 Apr 2020	STANDARD	-119	153	79
26 Apr 2020	STANDARD	280	527	79

↑ Figure 11. Screen copy - Clinical data report

During significant weight gain, the nephrologist may have to prescribe hypertonic bags for several days, associated with an increase in diuretics. Twenty-four-hour diuresis and stricter water restriction are also prescribed to the patient. The intervention of a dietician is recommended.

In the two patients in question, the weight curve returned to normal after a week.

• **Uncontrolled blood pressure**

Out of 20 patients, two presented refractory hypertension. The doctor had to make regular treatment changes and had to refer both patients to a cardiologist.

Summary of questionnaire answers

All of the patients who had a cyclor transfer experienced it without a problem. The questionnaire revealed a variety of responses which were not focused solely on the telemedicine aspect. The summary of the responses reported above showed a very good acceptance of the change in technique. Remote monitoring has made life easier for some patients, freeing them from tedious tasks such as copying their dialysis parameters. Only a few were stressed by the notion of network connection. Most had a better sense of security, to the point of considering going on vacation when they would not have dared on the conventional machine. This generally shows confidence in the healthcare team.

EXPECTED BENEFITS FOR THE MEDICAL TEAM AND PATIENTS

Since the introduction of telemedicine, we have seen many benefits for both the healthcare team and patients, especially during the COVID-19 pandemic.

On the care side:

With the PD follow-up consultations in the AIDER SANTE site being canceled during this period, the Sharesource platform allowed us to continue our daily monitoring and to quickly detect problems during this high-risk pandemic period to be able to intervene quickly. Only patients with serious problems were seen in the AIDER site. Previously, we discovered most of the issues during consultations every two months, with many patients not telling us so as not to disturb us (despite our availability).

During this period of lockdown, we also decided to continue our nursing home consultations by implementing a strict protocol validated by the hierarchy when we went to patients' home to avoid any risk of contamination. The referring nephrologist was then able to carry out his follow-ups in the form of remote consultations. Furthermore, the implementation of telemedicine did not increase the work of nursing teams quite the contrary. We are notified daily of a possible problem. This saves time for nurses in terms of organization to manage other issues.

The way we train patients and nurses in assisted patients has not changed. Indeed, only the connection to the network as well as the entry of the weight and arterial pressure were added, while the consumables remained the same.

The doctor, meanwhile, can readjust treatments as soon as he is alerted by the nursing team. During our telephone calls, it is with certainty and serenity that we make patients perform operations on their cyclers without fear of error since everything is visible on Sharesource.

On the patient side:

The daily monitoring as well as the maintenance of home consultations helped reassure many patients to not feel abandoned during this anxiety-provoking period. The feedback from patients on the use of the connected cycler is also positive.

Indeed, the majority of patients feel more secure and are less anxious, especially at the start of treatment. It allows some patients to go on vacation with greater peace of mind, which is highlighted in the questionnaire.

Unnecessary patient trips are avoided. Previously, the patient had to travel to have his card exported so that his dialysis sessions could be read and interpreted if necessary.

Some trust between the caregiver and the patient has grown, with most of them no longer monitoring their nighttime dialysis results other than their weight and blood pressure. However, patients still have the option of viewing their results on the dialysis register recorded on their cycler; this concerns one patient.

CONCLUSION

Two years has passed since we introduced telemedicine into our professional practice, and we have seen many benefits for both the medical team and the patients. Patient feedback on the use of a connected machine is positive with regard to the issue of stress and the feeling of security. The platform has become an essential tool in our daily practice. We can now provide adapted and rapid responses to patients' questions to avoid failing them.

CONFLICT OF INTEREST

The authors declare no conflict of interest for this article.

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