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Usefulness of telemedicine in the follow-up of peritoneal dialysis patients

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SUMMARY

Mean-term experience in the use of Telemedicine in Peritoneal Dialisis (PD) patients is limited as well as its cost-benefit.

*The main **objective** of this work is to evaluate Telemedicine utility in mean-long term control of stable PD patients, analyzing if the televisit (TV) could substitute 50% of the programed inhospital consults (HC) the time spent in both visit modalities, the quality of patient-personel contact as well as how image and sound have been perceived. Visit resolution was alalyzed taking into account the need of HC after a TV; We also have studied if it would be possible to retrain patients in the dialisis technique with telemedicine, and we have checked the patient perceived quality and calculate the real and social costs.*

***Methods:** during 18 months, the system has been implanted to 19 patients with 7 ± 4 follow up (range 3-17). A Falcon videoconference kit at patient's place was used, connected to the home television set. In the hospital there was a computer with a videoconference card, webcam and software meeting point which permits the control of patient's camera from the hospital. Both are connected by a 3RDSI line system. A monthly programmed HC or TV has been made. If more controls had been required, they have been made by TV. Time spent was recorded on each TV and patients and staff questionary were inquired.*

***Results:** a) Patients: mean age 44 ± 8 years, 13 (68%) male. 12 (63%) had elemental educational level and 7 (37%) mean-superior. 17 (89%) were actively working. The PD technique was: CAPD 6 (32%) and APD13 (68%).*

b) Televisits: 103 TV have been made. 22 ± 9 minutes were spent on each TV, less than in the HC, 33 ± 8 minutes ($p < 0.01$). There were technical problems related with lines in 21 TV, but only in 4 the connection was not possible. 92 TV (89%) were made on time, 99 (96%) had a good image quality and 96 (93%) had a correct sound. 100% of patients perceived TV as close to HC. In 90 TV (87%) medical treatment was modified. Only in 4 cases (3,9%) patients needed an hospital visit. According to patient's valuation, TV replaced correctly to HC in 97 instances (94%) and in 97 (97%) in staff opinion. In all cases (100%) catheter exit site could be evaluated as well as edema presence. Retraining was possible in all cases. There was a save in nurse'stime and patient'time and also, a save in physical hospital space. Initial investment apart, the daily cost increment was scarce (1.5 €) taking into account that there is a save in time for patients and personnel, save in physical space in hospital and in sanitary transport.

***Conclusion:** Telemedicine is useful from the clinical point of view in the mean-term for stable patients in PD. Daily cost increment is scarce and there is a save in time for patients and personnel, save in physical space in hospital and in sanitary transport.*

Key words: ***Telemedicina. Diálisis peritoneal. Televisita.***

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UTILIDAD DE LA TELEMEDICINA EN EL SEGUIMIENTO DE LOS PACIENTES EN DIÁLISIS PERITONEAL

RESUMEN

La experiencia a medio plazo del uso de la Telemedicina en pacientes en Diálisis Peritoneal (DP) es escasa y está poco clara la relación coste-beneficio.

*El **Objetivo** del presente trabajo es analizar si la Televisita (TV) puede sustituir al 50% de las Consultas hospitalarias (CH) de los pacientes estables en DP a medio plazo, si es posible el re-entrenamiento de los pacientes en la técnica con telemedicina, la calidad percibida por los pacientes y los costes reales y sociales.*

***Métodos:** a lo largo de 18 meses, el sistema se ha implantado a 19 pacientes con un seguimiento de 7 ± 4 meses (Rango 3-17 meses). Se ha utilizado en el domicilio del paciente un equipo de videoconferencia Falcon (Vcon), conectado a la televisión del paciente y en el hospital, un ordenador con tarjeta de videoconferencia, webcam y software meeting point, que permite el control desde el hospital de la cámara del paciente. Ambos se conectan mediante 3 líneas de RDSI. Se ha realizado de forma programada cada mes una CH o una TV. Si ha sido necesario mayor control, este se ha realizado por TV. En cada TV se contabiliza el tiempo empleado y se encuesta al paciente y al personal.*

***Resultados:** a) Pacientes: Edad media: 44 ± 8 años, 13 (68%) varones. Nivel de estudios: 12 primarios (63%) y 7 de grado medio-superior (37%). Están laboralmente activos 17 (89%). Se dializan con DPCA 6 (32%) y con DPA 13 (68%).*

b) Televisitas: Se han realizado un total de 103 TV. El tiempo medio de la TV es 22 ± 9 minutos, inferior al de la CH: 33 ± 8 minutos (p < 001). En 21 (20%) hubo problemas técnicos relacionados con las líneas, pero sólo en 4 ocasiones fue imposible la conexión. En 92 (89%) la conexión fue puntual, en 99 (96%) la calidad de la imagen fue buena y en 96 (93%) lo fue la calidad del sonido. El 100% percibió la TV como muy cercana al hospital. En 90 TV (87%) se modificó a distancia el tratamiento médico y sólo en 4 de ellas (3,9%) fue necesario que el paciente acudiera para ello al hospital. A juicio del paciente, la TV ha sustituido correctamente a la CH en 97 oasiones (94%) y en 97 (97%) a juicio del personal. En el 100% se pudo evaluar a distancia el orificio de salida del catéter y la existencia de edemas. El re-entrenamiento en la técnica fue posible en el 100%. Independientemente de la inversión inicial, el gasto diario sobre el coste de la diálisis peritoneal se incrementó en 1,5 €, ahorrándose tiempo al personal sanitario y al paciente, espacio físico en el hospital y transporte sanitario.

***Conclusión:** La Telemedicina es útil desde el punto de vista clínico en el seguimiento a medio plazo del paciente estable en Diálisis Peritoneal, requiriendo un incremento discreto en el coste de la técnica con un ahorro significativo de tiempo de personal y del paciente, de espacio físico en el hospital y de transporte sanitario.*

Palabras clave: ***Telemedicine. Peritoneal dialisis. Televisit.***

INTRODUCTION

Experience on application of telemedicine with renal failure patients on dialysis is scant. The first publications come from Australia in 1996[1], and simultaneously two projects were undertaken in the USA,[2,3] in which peripheral centers are connected to a central hospital. The first applications in home-based dialysis were done in the USA,[4] Australia,[5] Canada,[6] and Greece, with hemodialysis patients.

Although peritoneal dialysis (PD) is the most used technique nowadays in home-based dialysis, the experience with telemedicine is scant. Nakamoto *et al.*[8] have used it in elderly patients for a period varying from 1 to 6 months. Stroetman *et al.* at Empirica[9] and our department participated in the Euro-

pean pilot project ATTRACT, which consisted in developing videoconference services to support home-based management in several specialties. Preliminary results from this study concluded that it was possible to integrate the video-communication system in daily clinical practice, that patients' response was favorable, that good technology was needed in order to implement it, and that a long-term study was needed to show the clinical usefulness of telemedicine in the follow-up of PD patients as well as the cost-benefit ratio.

The aim of the present work is to assess the usefulness of telemedicine in the intermediate follow-up of stable PD patients specifically analyzing whether Tele-Visit (TV) may or may not replace 50% of scheduled hospital visits (HV), time dedicated to both types of visits, the quality of personal, and visual contact, and of the sound perceived by the patient and by health care staff, whether Tele-Visit has been resolving, or if it has been necessary for the patient to go later on to the health care center. The costs of both modalities, savings from health care transportation and the possibilities of re-teaching the patient in his/her dialysis technique are also analyzed.

METHODS

From September of 2003 to March of 2005, telemedicine has been used for the follow-up of stable PD patients already trained. The project has been approved by the hospital ethical and research committee.

Considering as relevant a time saving of 10 minutes in relation to HV, and an estimated loss to follow-up of 5%, the calculated sample size for a 90% power and 99% confidence interval of 99% is 15 patients.

Nineteen patients have been evaluated for a follow-up period of 7 ± 4 months (range: 3-17 months). They were randomly selected among prevalent and incident patients. Nine of them refused from the beginning to participate in the study and three others there were telecommunication troubles that prevented the implementation of the system. They were replaced by other patients. Similarly, as patients were discontinuing the technique, they were replaced by other patients. All patients signed an informed consent. Alternatively, they have been doing monthly a TV or a HV. In case of a patient needing a closer follow-up, this was done through TV. In all visits, time spent on the consultation has been computed and a patient survey has been done after each TV gathering the following information: punctuality in the connection, image and sound quality, presence of technical troubles during the connection, if the patient considered that the system intruded his/her home, if treatment was modified, if this resulted in attending the hospital, and if the patient considered that TV had appropriately replaced the HV. A similar survey was passed to health care personnel. In all cases, laboratory work-up was done monthly at the hospital, and weight and blood pressure were measured, and the data from the cycling-device (if present) were loaded into the hospital computer. All patients have performed a re-training in their PD technique consisting in reviewing the technique itself, care of the catheter outlet, and recognition of potential peritonitis.

The material used in the patient's home comprises a Falcon (Vcon) videoconference equipment, with an integrated camera that is connected to the TV set of the patient through a euro-connector. At the hospital, a computer is used with a Cruiser (Vcon) videoconference card and Meeting point software that allows controlling the patient's camera from the hospital (Fig. 1). The connection between the hospital and the patient's home is done through three RDSI lines. Some patients with automated dialysis also have a MODEM for transmitting the data from the cycling device to the hospital, or vice versa, through an analogical line.

RESULTS

Patients characteristics

Nineteen patients have been evaluated in total, followed for 7 ± 4 months (range 3-17 months). Mean age was 44 ± 8 years, 13 (68%) were male and 6 (32%) were females. Twelve (63%) have primary educational level, and 7 (37%) an intermediate or high degree educational level. However, 79% of them have some knowledge of computer user level. Seventeen (89%) are occupationally active. The PD technique used is: continuous outpatient peritoneal dialysis (COPD) in 6 patients (32%), and automated peritoneal dialysis (APD) in 13 (68%).

At the end of the follow-up period, 11 (58%) remained in the study, and 8 (42%) had withdrawn: 6 due to renal transplant, and two for switching to hemodialysis.

Tele-visit

One hundred and three tele-visits have been done in total. Mean time of TV has been at all times sig-

Fig. 1.— Equipment at the patient's home: videoconference equipment with a camera remotely controlled from the hospital. Equipment at the hospital: computer, videoconference card, and webcam.

nificantly lower than HV (fig. 2), with a mean saving time of 10 minutes in favor of TV, besides the saving time from transportation.

In 21 (20%) TV, there were technical problems with the connection, generally related with saturation of telephone lines. Only in four occasions, it was definitely impossible to perform the TV. In 92 (89%) occasions, the connection was timely, in 99 (96%) occasions image quality was very good and in 96 (93%) occasions the sound quality was very good. Three patients (15%) experienced the feeling at the beginning of the study that the system intruded their home, however all of them perceived TV as being very closed to the hospital. In 90 (87%) TV, medical treatment was modified from the hospital, and only in four (3.9%) the patient had to go to the hospital for treatment change.

TV has correctly replaced HV in 97 occasions (94%) according to patients, and in 97 (97%) according to health care staff.

In 100% of the cases, it was possible to check from the hospital the presence of edemas, the situation of the catheter outlet and of the dialysis fluid, as well as the real medication patients are taking.

Re-training

Re-training has done with each patient with regards his/her dialysis technique and peritonitis diagnosis and management. Mean times for retraining

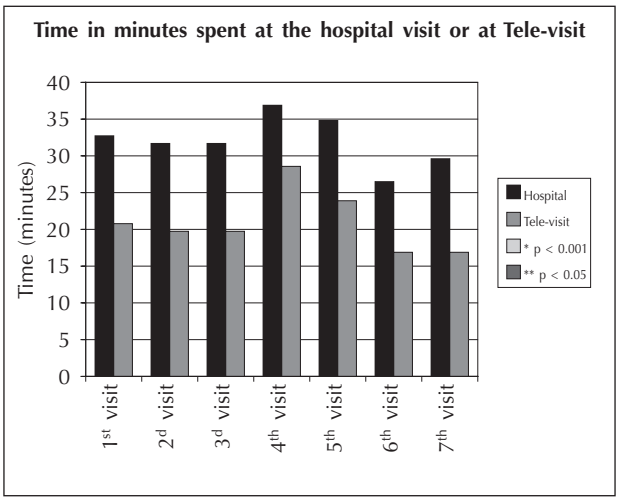

Fig. 2.— Comparison of time spent at Tele-visits and at scheduled hospital visits.

have been reduced in 15 minutes as compared to hospital retraining (60 ± 6 *versus* 45 ± 8 minutes). Assessment by the nursing staff yields that telemedicine has allowed them to save time and physical space at the hospital, allowing focusing better on that particular patient. The assessment by patients essentially yields time saving from commuting to the hospital.

Financial issues

The initial investment on videoconference equipment (4600 €) and on the three RDSI lines (500 €) is high, although the evaluated increase from telemedicine maintenance is of 1.5 €/patient/day of treatment, saving in transportation (either by oneself or by health care administrations), saving time to the patients and to the health care personnel, and physical space at the hospital.

Other aspects from Telemedicine

It is possible to know from the hospital the real medications that patients are taking, correctly see the dialysis graphs, blood pressure measurements in the case the patient is using electronic equipments, or blood sugar determination at the patient's home.

It is possible to rectify from the hospital the setting of on-line dialysis through the MODEM in patients having them, or manually in other cases. We have observed that systematic use of the MODEM to download the data unnecessarily prolonged the visit. From a time and easiness perspective, it has been more profitable to download the cycling devices memory card (Pro Chip Card, Baxter Healthcare Corporation) when the patient came to have his/her laboratory work-up and to keep the modem for those cases needing a closer monitoring of to modify the treatment at the TV.

It is possible to know and evaluate socio-sanitary issues of the patients with no need of the nurse home visit, saving time to the health care staff, as well.

DISCUSSION

Although Telemedicine is being applied since more than a decade ago in the field of end-stage renal failure, it is still no clear whether it represents a safe method of dispensing health care at a reasonable cost.[11] Two possible forms are usually employed: videoconference and remote telemetry.

About PD, there is a published experience with elderly patients on APD,[8] and more recently the same group of Japanese authors has reported the use of a connecting system through cellular telephones for capturing and analyzing the data from the cycling devices, with alarms for detected deviations from set parameters.[12] In Europe, preliminary results with adult patients[9,10] had indicated that the use of telemedicine in the care of PD patients would be possible, requiring high-quality technology and good functioning of the system to prevent disconnections that would distort the consultation. The need to perform long-term studies to confirm the validity of the system was indicated in both studies. In children there are a couple of published experiences[13,14] which indicated that the system facilitated the communication with the health care center and treatment adherence, although it was thought convenient not to implement this type of systems if it is estimated that treatment duration is going to be short, as it is the case for some children with priority for renal transplantation.

Our results firstly indicate that tele-visit is possible and reliable from a clinical perspective for follow-up of stable DP patients, being perceived as very close to hospital visit both from the patient and from health care personnel, and that it consistently saves consultation time, as it has been seen with other applications.[15] In the pilot study we could appreciate that very good technology was necessary for having images and sound in real time and of good quality: when in some occasions only two RDSI lines have been used, the image is seen as pixels and the sound becomes poor, rendering the interview diffi-

cult. With the technology we have used, the quality of both image and sound has been outstanding. The really important thing from a technical point of view in this study has been the proper functioning of telephone lines. We have had troubles in 20% of the tele-visits, especially at particular hours and days of the week, during which saturation of the telephone lines is likely to happen, although generally the visits could be finally done.

At the current experience, we have performed laboratory work-up once monthly at the hospital, and that particular day blood pressure and weight have been checked. One concern of the professionals caring for this type of patients has always been adherence to the prescribed treatment,[16,17] so that home visits have been stimulated, at least in part for that reason.

There are controversial opinions on the frequency of home visits. We believe that a close follow-up of home-based patients, particularly of those with poorer adherence, lonelier, or with greater difficulties from a socio-sanitary perspective, makes treatment adherence easier as a whole. With the current experience, we have been able to appropriately check blood pressure levels if the patient was using an electronic device, we have been able to adequately assess the existence of edemas, the situation of the PD catheter outlet and the real medication the patient is taking, as well as the characteristics of the dialysis fluid.

Besides bringing assurance and support, an interesting issue in home-based patients is to monitor that performance of the dialysis technique is correct, avoiding the perpetuation of possible mistakes. It is thus necessary to do regular patient retraining. We have used telemedicine for this purpose and we have verified that it has been possible in all cases with both PD techniques, that we save time, both to the patient and to the nursing staff, that we safe physical space at the hospital, and that it allows the nursing staff focusing on that particular patient during that time, something that is frequently difficult in a multi-compartimental unit, as usually are PD units.

Some departments do patient training at the patient's home itself.[18] It is likely that the system will be of help as a complement in that case.

From a financial perspective, currently videoconference equipments are expensive, as cycling devices are. In our case, equipments have been financed, which has allowed us to start the project with enough number of patients to bring forth conclusions. However, in spite of that initial expense, we believe that savings in health care transportation, in physical space at the hospital, and in the time consumed during the visit, by both the patient and the health care personnel, may compensate that initial expense from equipment, which besides may be transferred to other patients when the former discontinue the technique, as it happens nowadays with cycling devices. Therefore, we believe that a commitment from health care administrations and providers of PD material is necessary for its implementation, as it happens currently with contracts with automated dialysis or with special solutions.

The express authorization from patients for the use of this technology seems mandatory for the time being, as it occurs with other management issues. This document should be included in the patients' chart.

With the system used, it is unlikely that damages to patient's security may occur since telephone lines connect patient's terminal to hospital's terminal. The data transmitted in the case of suing a modem are encrypted, so that protection is high. It would be desirable that security in the Internet would be assured in view of the possible wider application of the Net for these purposes.

When answering the question "does Telemedicine have a future?" that en editorial posed three years ago,[19] and in which it was affirmed that in depended on the regular use in those medical areas in which it can be applied, we believe we have contributed to affirm that it can be included in daily clinical practice at PD units, and that in some cases it could facilitate the choice of home-based treatment by the patient. Clearly, with those patients expected to have a short stay on dialysis, as is the case of some children in whom a renal transplant is expected in the short term,[14] the implementation of telemedicine would not be recommended, although in other cases it has favored treatment adherence[13] and support to the parents. The absence of publications on telemedicine for PD in more developed countries such as the USA[20] is surprising, although it might be explained by lower interest in home-based dialysis because of financial reasons.

In our experience, occupationally active patients are the ones having better welcomed the new technologies because of the advantages they represent. The oldest ones have rejected them, as it generally happens with any kind of innovation, although in the long term, this may be one of the population groups that most may benefit from them. We believe we have also contributed to answer other questions formulated in relation to patient satisfaction.[20]

In summary, in our experience, telemedicine has been useful from the clinical perspective in the follow-up of stable PD patients, with an acceptable cost-benefit ratio.

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