

Home Dialysis in Japan

Contemporary Status.

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How Automated Peritoneal Dialysis Is Applied and Maintained in Japan

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Abstract

According to a nationwide statistical survey in Japan, only 9,858 patients (3.3% of dialysis patients) were on maintenance peritoneal dialysis (PD) at the end of 2009. In this survey, 8,635 patients answered questions about the PD method, while 1,223 patients did not respond. In Japan, at the end of 2009, 5,143 patients (59.6%) on PD were treated with CAPD and 3,492 patients (40.4%) on PD were treated with automated PD (APD). It is well known that around 20% of Japanese PD patients choose to apply and maintain PD + HD combination therapy. The number of PD + HD patients (1,569) accounted for 20.7% of the PD-treated patients (7,591). In Japan, patients with fluid overloading preferably select PD + HD combination therapy with or without icodextrin use. Young patients select APD while patients on PD suffered from fluid overloading with high transporter membrane. What then are the factors that effect APD selection in Japan? The use of various forms of APD has increased considerably in the past few years. Important factors that contribute to APD selection are better adjustment of APD to the patient's lifestyle and the flexibility that APD offers to patients. In addition, patients with APD will be able to have good quality of life (QOL). Young patients on PD select APD because of good QOL. It is well known that almost all of children younger than 19 years with end-stage renal disease (ESRD) are undergoing APD. APD has a pivotal role in the management of pediatric patients with ESRD. Children on APD had a lower incidence of peritonitis compared with those with CAPD. The switch from CAPD to APD resulted in better ultrafiltration, less edema, lower mean arterial blood pressure, lower peritonitis rate and fewer hospital admissions. As in young patients, APD is also good method to select in elderly patients on PD. The need for the exchange to be performed by another person is increased in elderly and handicapped ESRD patients, however APD therapy is a good selection for them because of the smaller number of manipulations, resulting in a substantial reduction of help required. In the future, telemedicine systems with APD may be play an important role for young and elderly patients on PD.

In recent years, important advances have been made in the treatment of patients with end-stage renal disease (ESRD) [1]. ESRD patients and their physicians must consider many factors, e.g. age, sex, profession, quality and length of life, when choosing a treatment regimen. Because of the limited number of donor organs, most patients must undergo dialysis [2, 3]. The distribution of patients with ESRD among transplantation, hemodialysis (HD) and peritoneal dialysis (PD) therapy differs dramatically in Japan and other countries.

According to a nationwide statistical survey in Japan, the total number of dialysis patients in Japan at the end of 2009 was 290,661, as determined from the facility survey. The number of dialysis patients in Japan at the end of 2008 was 283,421, an increase of 7,240 patients (2.6%) from the end of 2008. [4]. On the contrary, according to the facility survey, the number of PD patients was 9,858 at the end of 2009, an increase of 558 patients from the 2008 survey (9,300 PD patients). Moreover, the number of non-PD + catheter patients was 437 and that of new patients who were started on PD in 2009 but introduced to other therapies in the same year was 196. The total number of these PD therapy-related patients was 633. These 633 patients were not classified as PD patients in the previous surveys. The sum of these 633 patients and the above-mentioned PD patients (i.e. the total number of PD therapy-related patients) was 10,491. At least 500 or more PD patients were increased because in this 2009 survey, non-member facilities that treated only PD patients were included in the survey although they were not included in the previous surveys. However, the ratio of PD patients is very small compared to other countries.

One reason for this great difference in the number of dialysis patients in Japan was due to the good outcome of HD in Japan. In 2003, a prospective, observational HD study across seven countries, The Dialysis Outcomes and Practice Patterns Study (DOPPS), was reported [5, 6]. The crude 1-year mortality rates were 6.6% in Japan, 15.6% in Europe, and 21.7% in the USA. This data clearly demonstrates the good outcome of Japanese HD patients compared to other Western countries. On the other hand, what is the trend of Japanese ESRD patients on PD? Outcomes among PD patients differ considerably between and within countries [7, 8]. One of the most concerning differences is the varying technical survival and patient survival across countries [9]. We have previously already clearly reported that the outcome of Japanese PD patients including technical survival and patient survival are extremely good compared to other countries [10].

Dialysis Trends in Japan – A Nationwide Statistical Survey

In a nationwide statistical survey of 4,196 dialysis facilities conducted in Japan at the end of 2009, 4,133 facilities (98.5%) responded. The number of patients undergoing dialysis at the end of 2009 was determined to be 290,661, an increase of 7,240 patients (2.6%) compared with that of 2008. The number of patients

Table 1. Japanese PD patients classified by D/P creatinine (APD = NIPD + CCPD = 3,492)

PET	<0.5	0.5–0.64	0.65–0.80	0.81–1.00	PET All	Unknown	Total
CAPD	176	589	642	206	1,613	3,530	5,143
(%)	(59.3)	(58.1)	(59.9)	(54.9)	(58.5)	(59.8)	(59.4)
NIPD	78	272	275	133	758	1,580	2,338
(%)	(26.3)	(26.9)	(25.7)	(35.5)	(27.5)	(26.8)	(27.0)
CCPD	40	146	145	34	365	789	1,154
(%)	(13.5)	(14.4)	(13.5)	(9.1)	(13.2)	(13.4)	(13.3)
Total	297	1,012	1,071	375	2,755	5,899	8,654
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

newly introduced to dialysis was 37,566, a decrease of 614 (–1.6%). The number of decreased patients was 27,646, an increase of 380 (–1.4%). From this survey the increased number of patients was 9,920.

The number of dialysis patients per million at the end of 2009 was 2,279.5. The crude death rate of dialysis patients from the end of 2008 to the end of 2009 was 9.6%. Primary renal diseases in patients who newly started chronic dialysis in Japan in 2003 had diabetes mellitus (DM; 44.5%), chronic glomerulonephritis (CGN; 21.9%), nephrosclerosis (8.5%), and polycystic kidney disease (PCK; 2.3%). In 1993, primary kidney diseases were CGN (41.4%), DM (29.9%), nephrosclerosis (10.7%) and PCK (2.3%). The increased incidence of ESRD in diabetes in Japan was similar to the data of the United States Renal Data System (USRDS) report where the rate of DM and CGN had completely changed within 10 years. The dialysis patient population in Japan has been getting older on an annual basis.

In 2009, the mean age of new patients introduced to dialysis was 67.3 years; the mean age of the entire dialysis patient population was 65.8 years. In 1993, the mean age in all patients who started chronic dialysis was 59.8 years. The mean age of the dialysis population during the past 10 years has increased by 0.6–0.7 years annually [4].

Trends of CAPD and APD in Japan

It is well known that APD is now the fastest growing PD modality, and in some programs the majority of PD patients are treated with APD (table 1). The use of various forms of APD has considerably increased in recent years, mainly because of technological improvements and better adjustment to various patient lifestyles. The trend towards increased utilization of APD has been reported by French registry data: a rise in the use of APD to 36% in 2005 from 23% in 1995 [11]. According to a nationwide survey in Japan in 2005, 33.4% of PD patients

were treated with APD. As well as other countries, a rise in the use of APD to 40.4% in 2009 from 34.4% in 2005 has been observed in Japan.

According to a nationwide statistical survey in Japan, only 9,858 patients (3.3% of dialysis patients) are on maintenance PD at the end of 2009. In this survey, 8,635 patients answered questions about the method of PD, while 1,223 patients did not respond. At the end of 2009, 5,143 patients (59.6%) on PD in Japan were treated with CAPD and 3,492 patients (40.4%) on PD were treated with APD. About 40% of PD patients were on maintenance APD in Japan in 2009 (table 1).

APD methods are traditionally divided into continuous cycling peritoneal dialysis (CCPD) and nocturnal intermittent peritoneal dialysis (NIPD). According to the nationwide survey in Japan, 2,338 patients were divided into NIPD and 1,154 were divided into CCPD. Of the APD patients, 67.1% were on NIPD and 32.9% were on CCPD.

According to the International Society of Peritoneal Dialysis (ISPD), APD is widely recommended for the management of high transporters [12]. A nationwide survey in Japan reported the D/P creatinine of PD patients at the end of 2009. Average D/P creatinine in patients on PD is 0.65 ± 0.14 . How much is the average D/P creatinine according to the methods? In patients on CAPD, average D/P creatinine is 0.65 ± 0.13 (means). In patients on APD, NIPD and CCPD, averages of D/P creatinine are 0.66 ± 0.15 and 0.64 ± 0.14 , respectively. There are no significant differences of D/P creatinine among these three groups. In other words, D/P creatinine is the same. Table 1 shows the method of selection of PD patients in Japan.

PD + HD Combination Therapy and Icodextrin in Japan

According to the results of the patient survey at the end of 2009, the number of patients who responded that they were undergoing only PD (referred to as 'PD-only patients') was 6,022. Therefore, the total number of these and the number of PD + HD patients (1,569) was 7,591. The other 2,267 patients were divided into unknown patients. Among these 7,591 PD patients, 1,197 (15.8%) underwent HD once a week, 191 (2.5%) did so twice a week, and 53 (0.7%) did so 3 times a week. PD + HD patients (1,569) accounted for 20.7% of the PD-treated patients (7,591). In addition, according to a nationwide statistical survey in Japan, 51.6% of ESRD patients on PD use polyglucose dialysis solution, i.e. icodextrin (Extraneal). Half of ESRD patients on PD use icodextrin. This is extremely high compared to other countries.

In CCPD patients, the patient carries a glucose-based PD solution in the abdominal cavity throughout the day, but performs no exchanges and is not attached to a transfer set. At bedtime, the patient hooks up to an automated cyler that will change the dialysis solution in his abdomen three or more times

in the course of the night. In the morning, the patient, with the last dwell of glucose-based or icodextrin (Extraneal) remaining in the abdomen, disconnects from the cyclor and is free to go about daily activities. In Japan, CCPD with icodextrin is called E-APD. E-APD is a good method for PD patients with a high and high-average transporter to achieve a good ultrafiltration volume. The E-APD method is widely selected by APD patients in Japan.

Comparison of APD and CAPD

Over the last decade there has been an increasing application that peritoneal membrane transport characteristics play a crucial role in determining the morbidity, mortality and management of PD patients [12–16]. Patients with high peritoneal permeability (PET: high transporters) have been shown to have a substantially increased risk of death and technique failure, in spite of their more rapid diffusive clearance of urea and creatinine [16–19]. This increased risk has been attributed at least partly to rapid clearance of the glucose-associated osmotic gradient across the peritoneal membrane leading to ultrafiltration failure and fluid overload [14, 15]. There is evidence that patients with symptomatic fluid retention are 3.7 times more likely to be high than low transporters [20]. Modeling studies suggest that ultrafiltration in high transporters should be maximized by prescription of short dwell therapies by using APD [12]. Consequently, the ISPD Ad Hoc Committee on Ultrafiltration Management in Peritoneal Dialysis strongly recommends APD for the treatment of high transporter with impaired net ultrafiltration [12].

APD is widely recommended for the management of high transporters by the ISPD, although there has been no adequate evidence to date comparing the outcomes of APD and CAPD [12]. One prospective, open-label, randomized, multicenter controlled trial of APD vs. CAPD in 25 prevalent PD patients who were high or high-average transporters observed no significant changes in net filtration and was not statistically powered to evaluate survival outcomes [21]. A subsequent meta-analysis of three randomized controlled trials of APD vs. CAPD involving 139 patients did not find any differences in patient or technique survival, but was inadequately powered to assess these outcomes and did not perform subgroup analysis in high transporters [22]. For the most important point of method selection in APD, there is evidence which method has the better effect on survival and technique survival rate in patients on PD. There are some new findings of APD about the good effect on survival and technique survival rate. Johnson et al. [23] reported from an Australian and New Zealand Database that APD treatment is associated with a significant survival advantage in high transporters compared with CAPD (HR 0.59, 95% CI 0.35–0.87). However, APD treatment is associated with inferior survival in low transporters (HR 2.19, 95% CI 1.02–4.70). Cnossen et al. [24] reported that patient survival

was not significantly different between APD and CAPD, whereas the technique of survival appeared to be higher in APD patients. Sun et al. [25] reported from the US Renal Data System (USRSD) that technique and patient survival are similar with APD and CAPD. Younger Chinese patients on APD have better patient and technique survival than do those on CAPD. However, there is a strong possibility that this benefit may be confounded or accounted for by baseline differences between the APD and CAPD populations.

How to Apply and Maintain APD in Japan

According to a nationwide survey in Japan, peritoneal membrane transport status has no effect on APD selection (table 1). Why then do Japanese patients not necessarily select APD with a high permeability of peritoneal membrane?

It is well known that around 20% of Japanese PD patients choose to apply and maintain PD + HD combination therapy. The number of PD + HD patients (1,569) accounted for 20.7% of the PD-treated patients (7,591). In Japan, patients with fluid overloading preferably select PD + HD combination therapy with or without icodextrin use. Young patients select APD when patients on PD suffered from fluid overloading with a high transporter membrane.

What then are the factors that effect APD selection in Japan? The use of various forms of APD has increased considerably in the past few years. Important factors contributing to APD selection were better adjustment of APD to the patient's lifestyle and the flexibility that APD offers. In addition, from the point of quality of life (QOL), patients with APD will be able to have good QOL. Young patients on PD select APD because of good QOL. Almost all young patients under 19 years of age select APD because they have to go to school. It is well known that almost all children younger than 19 years with ESRD are undergoing APD [26]. APD has a pivotal role in the management of pediatric patients with ESRD [27]. Children on APD had a lower incidence of peritonitis compared to those with CAPD [28]. The switch from CAPD to APD resulted in better ultrafiltration, less edema, lower mean arterial blood pressure, a lower peritonitis rate and fewer hospital admissions [29].

Over a 24-hour period, APD involves only one connection in the night and only one disconnection in the morning. CAPD involves four connections and four disconnections. The smaller number of manipulations required from the patient could result in a substantial reduction in the incidence of peritonitis. It is well known that APD has been associated with improved compliance, lower intraperitoneal pressure and a lower incidence of peritonitis. Increased intraperitoneal pressure can be a problem during the application of PD and may result in the occurrence of hernias and fluid leaks causing discomfort (pleuroperitoneal communication) for some patients on PD. Lower abdominal pressure improves some complications of PD, including hernia and pleuroperitoneal communication.

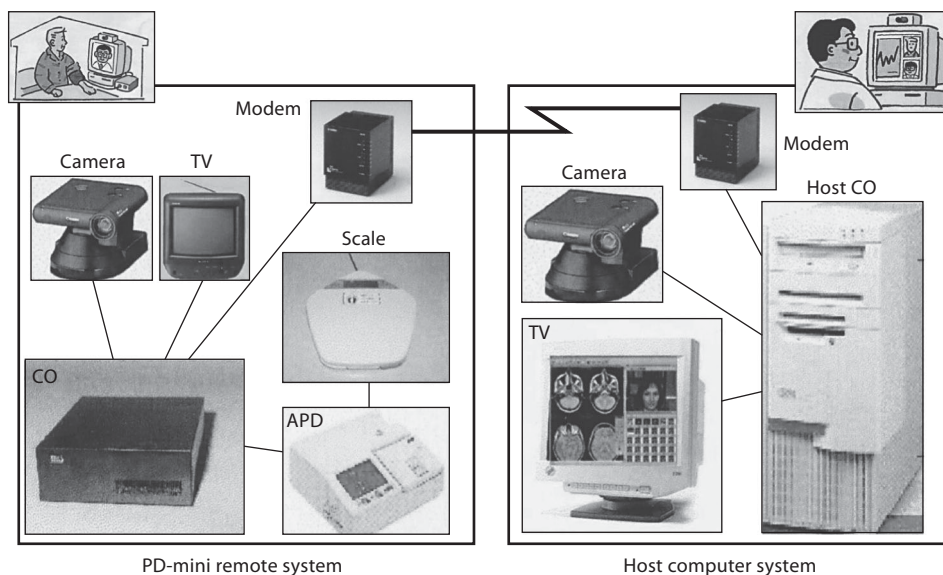


Fig. 1. Version 1.0 of a newly developed telemedicine system for CAPD patients using APD. In recent decades the rapid progression of information and telecommunication technology has evoked application of these techniques in the medical field. We have developed a telemedicine system to monitor elderly and handicapped PD patients by using an APD system (PD-mini; JMS Co., Tokyo, Japan).

As in young patients, APD is suitable in elderly patients on PD, especially in those with good residual renal function. The need for the exchange to be performed by another person is increased in elderly and handicapped ESRD patients [30]. APD therapy is a good selection for these patients because the smaller number of manipulations required results in a substantial reduction of help required. In fact, because of the increasing number of elderly patients on PD in Japan, these changes could explain the increased use of APD in general.

New Technology Using an APD Telemedicine System

For the purpose of monitoring elderly ESRD patients on PD, APD with a telemedicine system is a good selection for such cases. In recent decades, rapid progression of information and telecommunication technology has evoked application of these techniques in the medical field. We have developed a telemedicine system to monitor elderly and handicapped PD patients by using an APD system (PD-mini; JMS Co., Tokyo, Japan) (fig. 1) [31–34]. Using this system, we can retrieve all data directly, including blood pressure (BP), heart rate (HR), ultrafiltration volume (UF) and body weight (BW) (fig. 2).

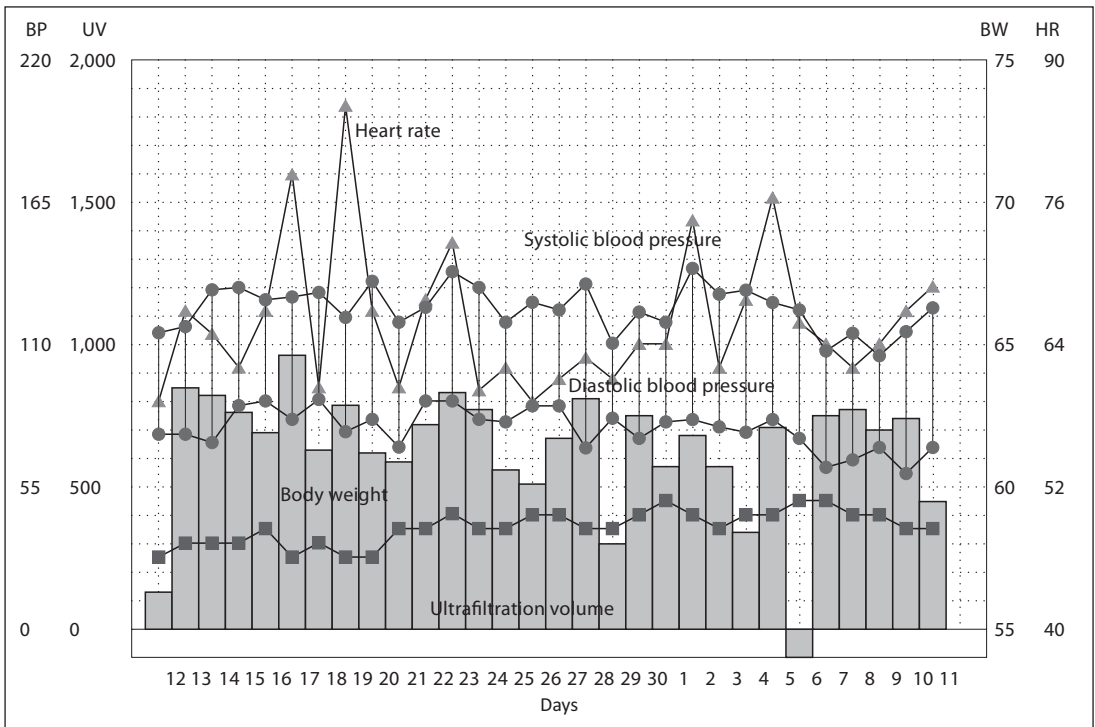


Fig. 2. Patient data on an internet website using the APD telemedicine system. With this system we can retrieve all data directly, including blood pressure (BP), heart rate (HR), ultrafiltration volume (UF) and body weight (BW).

This telemedicine system was constructed by two different systems including (i) a data transport system and (ii) a ‘view send’ system (video conference system). This system was constructed by two different systems including (i) a data-collecting and monitoring system by using APD and (ii) a medical record-sharing system in a computer internet website system by using an application service provider (ASP).

After 2003, to collect the data from a fully automatic device to a cellular phone, we developed a fully automatic data-collecting system named an I-converter (version 3.0; fig. 3). The data of PD patients including BP, HR, BW, blood glucose, and UF were directly sent to the main server constructed in a central data center by using an APD system and the I-converter. All data were collected on the central data center’s main server which was directly connected to an internet website using application service provider technology (ASP). Doctors can check these data on an internet website anytime and anywhere with the patient’s permission. This system has great advantages for elderly and handicapped patients because they do not need to visit the outpatient clinic. In addition, we can

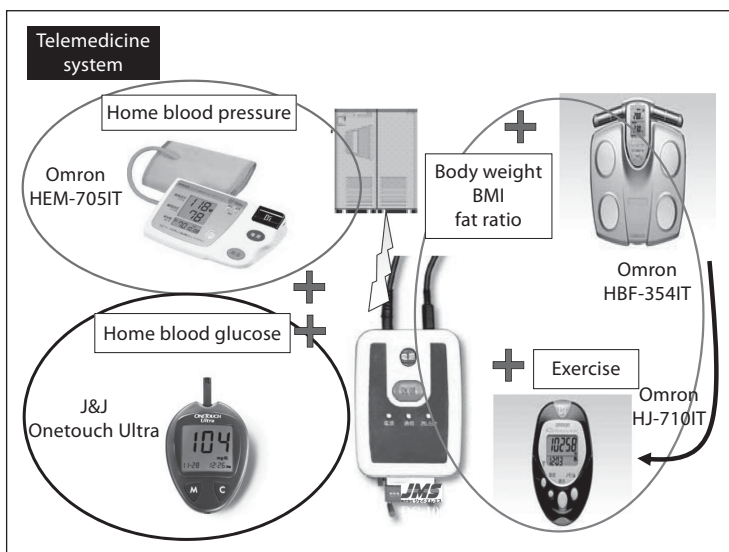


Fig. 3. Version 3.0 of telemedicine system to collect data at home.

monitor these patients at home in a real-time. In the future, telemedicine systems with APD may play an important role in young and elderly PD patients.

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