

# Continuous ambulatory peritoneal dialysis: three and a half years experience in Languedoc-Roussillon

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## SUMMARY

From September 1978 to February, 28th 1982 123 patients were treated for one month or more with CAPD in Languedoc-Roussillon. The mean age was  $56.7 \pm 15$  years.

The patients used acetate buffer dialysate in 2 l. plastic bags. For dialysate infusion, the patients wore a special connecting device including bacteriological filter and iodine-box shielding the connection dialysate bag-connecting device.

**Outcome:** 50 patients were still on CAPD, 23 had been transferred to IPD and 13 to HD, 35 patients died, one was transplanted and CAPD could be interrupted in one patient due to improvement in renal function. The main reasons for transferring to other dialysis modalities were: a loss of peritoneal capacity to ultrafiltrate (15 patients), patient's preference (6), patient's dependence on a helper (5), inadequate dialysis (4) and peritonitis (4).

**Peritonitis:** 87 episodes of peritonitis occurred in 52 patients (42 %) there were 68 (72 %) infectious episodes (78 % Staphylococcus; 15 % gram negative bacterie; 7 % fungi). There were 19 episodes (28 %) of cryptogenetic (sterile) peritonitis, the overall incidence was 1 episode every 1.6 patient treatment years. The actuarial risk of having a first episode of peritonitis was of 50 % at one year.

**Morbidity:** In 99 patients the duration of hospitalisation was 35.8 days per year, evaluated prospectively. The main reasons for hospitalisation were cardiovascular problems and peritonitis.

**Mortality:** The main cause of death were: Cardiovascular diseases (48 %); visceral cancer (17.1 %) and peritonitis (11.4 %).

**Key words:** CAPD, Survival on CAPD.

## RESUMEN

En el programa de diálisis de Languedoc-Roussillon se han tratado en DPCA 123 pacientes por períodos superiores al mes, desde septiembre de 1978 hasta el 28 de febrero de 1982. La edad media fue de  $56,7 \pm 15$  años.

Se utilizaron bolsas de plástico flexibles con 2 litros de líquido conteniendo acetato. Se empleó un sistema de doble vía con filtro bacteriológico y cajita de protección en la conexión Bolsa-sistema con povidona iodada.

**Seguimiento:** 50 pacientes continúan en DPCA, 23 pasaron a DPI, 13 a HD, 1 fue trasplantado y 1 recuperó función renal. Las principales causas de abandono fueron: pérdida de capacidad de ultrafiltración (15 pacientes), voluntad del paciente (6), necesidad de ayudante (5), diálisis inadecuada (4) y peritonitis (4).

**Peritonitis:** 52 enfermos (42 %) sufrieron 87 episodios. En 68 casos (72 %) se cultivó algún germen (78 % staphylococos, 15 % gram negativos, 7 % hongos), en los 19 restantes los cultivos fueron negativos. La incidencia global fue de un episodio cada 1,6 años de tratamiento. El riesgo actuarial de padecer el primer episodio fue del 50 % al primer año de tratamiento.

**Morbilidad:** Se evaluó prospectivamente la hospitalización de 99 pacientes, con un tiempo medio de tratamiento de  $0,85 \pm 1$  años, entre el 1-9-1980 y el 28-2-1981, excluyendo los días destinados al entrenamiento. La duración de hospitalización resultó de 35,8 días por año. Las causas más importantes fueron los problemas hemodinámicos, cardiovasculares y peritonitis.

**Mortalidad:** Las causas de muerte más frecuentes fueron: enfermedad cardiovascular (48 %), cáncer visceral (17,1 %) y peritonitis (11,4 %).

**Palabras clave:** DPCA, supervivencia en DPCA.

**INTRODUCTION**

Since September 1974, home intermittent peritoneal dialysis (IPD) was developed in Languedoc-Roussillon as an alternative to haemodialysis (HD) in order to provide access to end stage renal disease (ESRD) therapy to older (65 years old or more) and/or sicker patients that could not be treated because of a lack of in-center HD facilities. Home IPD was successful in insuring long term treatment to this group of patients as published earlier<sup>1,2</sup> and was associated with a peritonitis incidence of 1 peritonitis episode every 5.7 patient treatment years<sup>3</sup>.

In 1978, acknowledging the potential advantages of CAPD recently introduced by Popovich et al.<sup>4</sup>, we faced an ethical dilemma resulting from the extremely high incidence of peritoneal infection reported in early CAPD series<sup>5,6</sup> as compared to the low incidence observed among our IPD patients. Furthermore, the development of an active home HD programme (40% home HD patients) and the increase in HD centres in our area with 40 dialysis beds per million population allowing the easy acceptance on HD of the younger ESRD patients removed any pressure justifying the use of CAPD as a main therapeutic alternative to HD.

In this context, we started our CAPD programme in September 1978 with the following guidelines:

1. An attempt would be made to reduce the peritoneal infection rate by using a bacteriological filter in the dialysate infusion line.
2. All patients admitted on PD would be given the possibility to choose either IPD or CAPD after effectively trying each method.
3. Younger patients (less than 60 years old) would be admitted on CAPD exclusively on a voluntary basis.

This report summarises our experience in treating ESRD patients with CAPD, emphasizing the efficiency of our technique in controlling peritoneal infection and the necessity of alternative dialysis techniques (HD and/or IPD) in case of CAPD failure.

**PATIENTS AND METHODS**

**Patients**

From September 1978 to February, 28th, 1982, 143 patients were admitted on CAPD. There were 84 males and 59 females, with a mean age of  $56.7 \pm 15$  years; figure 1 shows the sex and age group distribution of this population. One hundred and twenty-three patients received CAPD for one month or more; 20 patients received CAPD for shorter periods, ranging from 4 to 20 days, choosing to continue their treatment with IPD as a more suitable form of therapy.

Among the 123 «long term» CAPD patients, 63 received CAPD as the primary form of treatment, whereas

60 patients were transferred from IPD (previous treatment duration:  $1.1 \pm 1.2$  years).

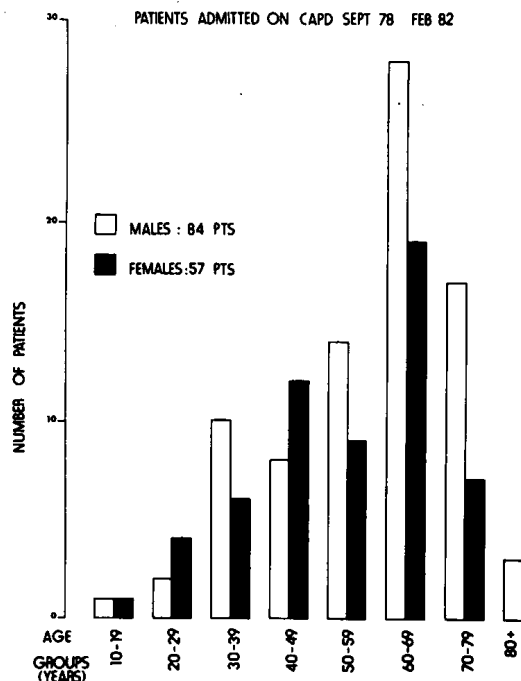


Fig. 1.—Age group and sex distribution in 141 patients admitted on CAPD from September 1978 to February 1982.

**Dialysis technique**

The patients used acetate buffer dialysate in 2-L plastic bags; the composition of the five available solutions (Laboratoires Aguettant, Lyon, France) is shown on Table I. For dialysate infusion, the patient wore a special connecting device permanently attached to the Tenckhoff catheter; the connecting device, described in detail elsewhere<sup>7</sup>, included a bacteriological filter with a 0.22 µm. pore size membrane (Twin 90, Millipore Corp., Bedford Massachusetts, USA) on the dialysate infusion line and a by-pass line for drainage (fig. 2). The luer connection attaching the dialysate bag to the connecting device was shielded by a plastic case made of two half shells the inner surface of which was lined by a plastic foam soaked with polyvidone iodine («Iodine box») as shown on fig. 3. Each connecting device was

TABLE I  
DIALYSATE COMPOSITION

	I	II	III	IV	V
Sodium . . . . .	mmol/l. 130	140	130	140	130
Potassium . . . . .	mmol/l. 0	0	0	0	0
Chloride . . . . .	mmol/l. 97	97	97	97	97
Acetate . . . . .	mmol/l. 35	35	35	35	35
Calcium . . . . .	mmol/l. 1.75	1.75	1.75	1.75	1.75
Magnesium . . . . .	mmol/l. 0.35	0.35	0.35	0.35	0.35
Dextrose . . . . .	g/l. 15	15	25	25	40

Prepared by Laboratoire Aguettant, Lyon, France.

used for 10 to 15 consecutive days and was changed when the dialysate infusion time increased up to 35 minutes. The connecting device was changed by the patient and his spouse following strict sterile procedures with a mask, a cap, gloves, sterile drapes and careful cleansing of the connection between the Tenckhoff catheter and the device.

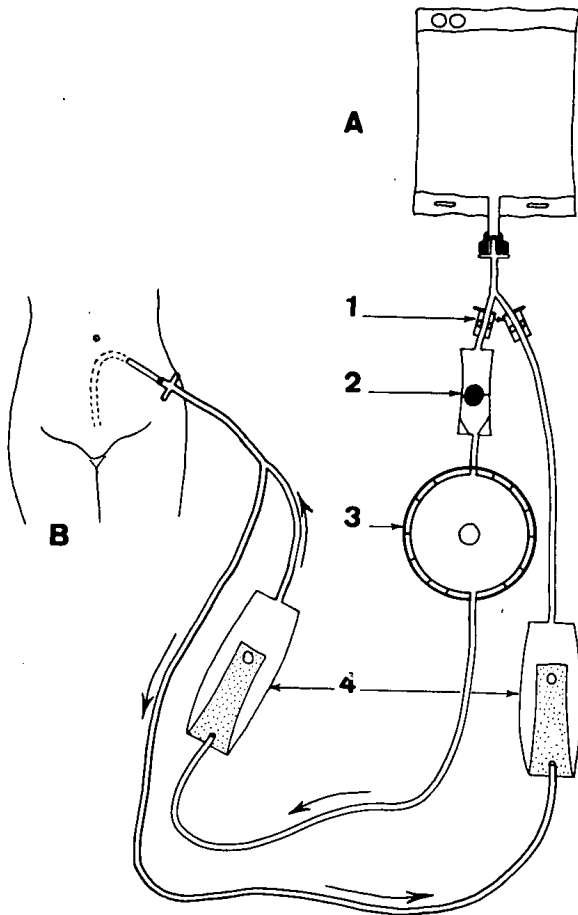


Fig. 2.—CAPD connecting device with a microbiological filter on the dialysate infusion line. 1) manual clamp; 2) bubble trap; 3) filter; 4) check-valves for unidirectional flow.

The number of daily dialysate exchanges was 4 in 85 % of the patients, 3 in 12 % and 5 in 3 %. For bag exchange, the patient was trained in a simplified technique consisting in a 3 min. handwashing, the use of a disposable sterile paper drape and the cleansing of the luer connection with a iodinated gauze before opening the circuit and connecting the fresh dialysate bag. The bag exchange per se took about 10 min.

### Patient training

All patients were trained at our home peritoneal dialysis training centre (Clinique Médicale du Mas de Rochet, 34170 Castelnau-le-Lez) and tried successively IPD and CAPD, each technique being used for at least one week. In this way, the patients were free to make their own choice concerning the most suitable form of therapy for long term home treatment.

Subsequently, if a patient had to be transferred from one technique to the other (for medical or personal reason), he was readmitted at the centre and trained to the alternate therapeutic mode.

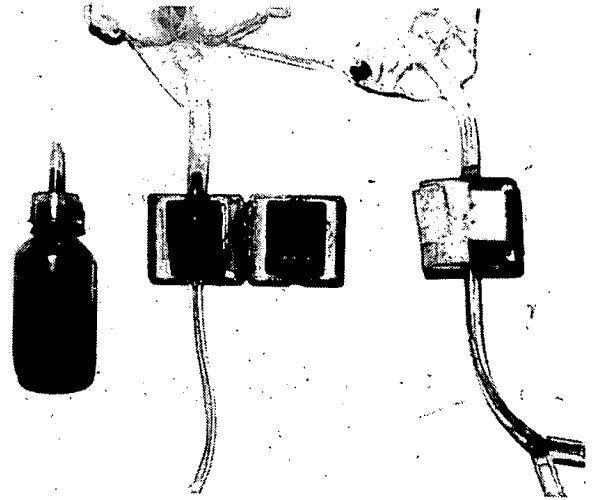


Fig. 3.—«Iodine Box» (see text). In the centre of the figure: open at the time of bag exchange. On the right: closed around the luer connector.

### Peritoneal infection

Peritonitis was defined as a cloudy peritoneal drainage persisting for more than two consecutive exchanges, whether or not it was associated to typical signs and symptoms. When a peritonitis was suspected, the patient came to the centre for dialysate culture using either standard microbiological techniques<sup>8</sup> and/or dialysate filtration<sup>9</sup>.

All peritonitis episodes were included in the computation of peritoneal infection rate, whether the peritoneal fluid cultures were positive or negative (septic versus cryptogenetic peritonitis).

### Statistical analysis

To take into account the time factor which plays a central role in the occurrence of peritonitis among CAPD

TABLE II  
OUTCOME OF 123 PATIENTS ADMITTED ON CAPD FOR ONE MONTH OR MORE («LONG TERM» CAPD)

	50 CAPD
End stage renal disease 63 patients	23 IPD 13 HD
Home IPD 60 patients (1.1 ± 1.2 years)	Long term CAPD 123 patients 35 deaths 1 transplant 1 remission

patients, the method of life table analysis<sup>10</sup> was chosen to calculate the risk of having a first peritonitis episode; this percent actuarial risk was calculated both for the whole population (123 patients treated for one month or more) and for 3 subgroups of patients defined according to their time of entry into the CAPD programme (group I: 46 patients admitted from 1st September 1978 to 31st August 1979; group II: 37 patients admitted between 1st September 1979 and 31st August 1980; group III: 30 patients admitted between 1st September 1980 and 31st August 1981).

**RESULTS**

**Outcome**

As indicated in Table II, among the 123 patients treated with «long term» CAPD (one month or more) 50 were still on CAPD by the end of February 1982, 23 had been transferred to IPD and 13 to HD; 35 patients died, one was transplanted and CAPD could be interrupted in one patient due to improvement in renal function. The main reasons for transferring 36 patients to IPD and/or HD were a loss of peritoneal capacity to ultrafiltrate (15 patients), patients' preference (6 patients), patients' dependence on a helper (5 patients), inadequate dialysis (4 patients) and peritonitis (4 patients), as shown in Table III.

40%

**Peritonitis**

87 episodes of peritonitis occurred in 52 over 123 patients (42%). There were 68 infectious episodes (72%) with positive cultures for Staph. epidermidis and Staph. aureus in 78% of the cases; gram negative bacteria and fungi were isolated in 15% and 7% of the cases respectively. There were 19 episodes of cryptogenetic (sterile or culture negative) peritonitis, repre-

senting 28% of the peritonitis episodes. The overall incidence of peritonitis was 1 episode every 1.6 patient treatment years (Table IV). The actuarial risk of having a first episode of peritonitis was of 50% at one year as shown in fig. 4.

**ACTUARIAL RISK OF HAVING A FIRST EPISODE OF PERITONITIS (SEPTIC AND/OR STERILE) AFTER STARTING CAPD.**

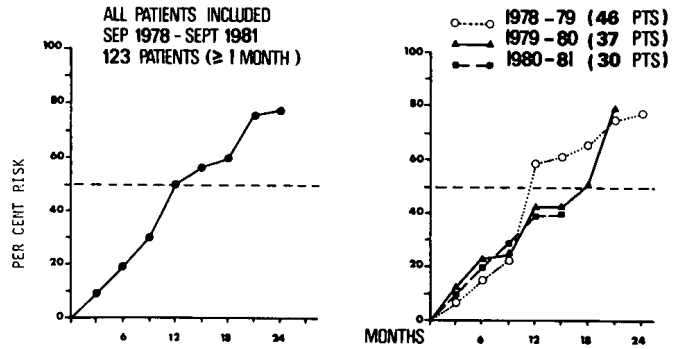


Fig. 4.—Per cent risk of having a first episode of peritonitis. A) calculated in 123 patients treated for one month or more; B) calculated among 3 groups of patients according to the year of admission on CAPD.

**Morbidity**

In 99 patients, the number of days spent in hospital was evaluated prospectively from 1st September 1980 to 28th February 1982, excluding the training time. In this group of patients, with an average treatment duration of 0.85 ± 1 year (mean ± SD), the duration of hospitalisation was 35.8 days per year. The cause for hospital admission are indicated in Table V: extracellular volume overload, and/or congestive cardiac heart failure, other cardiovascular problems (coronary artery disease, cardiac arrhythmia, arteritis) and peritonitis were the main reasons for hospital admission.

**Causes of death**

The causes of death observed in 35 patients are presented in Table VI: the three leading causes were cardiovascular diseases in 17 patients (48.6%), visceral cancer in 6 patients (17.1%) and peritonitis in 4 patients (11.4%). CAPD was discontinued in 3 patients with cerebroscerosis and progressive senile dementia.

**Integration of CAPD and IPD**

The number of new patients treated with CAPD since the inception of our programme and the number of patients treated by CAPD at the end of each year are shown in fig. 5. The number of new patients admitted each year on CAPD from 1978 to 1980 increased from 12 to 27, but it was only 20 in 1981. On the other

TABLE III  
REASONS FOR TRANSFERRING 36 CAPD PATIENTS ON IPD OR HD

	Number of patients	Mean treatment duration (years)
<b>A) Transfer to IPD</b>		
Inadequate UF	13	1.4 ± 0.9
No independence on CAPD	5	0.1 ± 0.12
Patient's preference	3	0.3 ± 0.75
Hyperglycemia	1	
Hypertriglyceridemia	1	
	23	
<b>B) Transfer to HD</b>		
Inadequate UF	2	
Inadequate dialysis	1	1.4 ± 1.3
UF ↓ + Inad. dialysis	3	
Technical problems after peritonitis	4	1.1 ± 1.3
Patients preference	3	0.5 ± 0.1
	13	

TABLE IV  
INCIDENCE OF PERITONITIS IN CAPD

Number of patients	
Total	143
Treated > 1 month	123
Patients with peritonitis (%)	52 (42.3)
Treatment duration (years)	
Cumulative	137.3
Mean per patient	1.1 ± 0.8
Range	3.2 ± 0.08
Number of peritoneal infections	
Infectious (%)	68 (72)
Cryptogenetic (%)	19 (28)
Incidence per patient treatment year	1/1.6

hand, the total number of CAPD patients increased steadily from 12 in December 1978 to 56 in December 1981, whereas the number of patients on IPD decreased from 78 on 31st December 1977 to 56 on 31st December 1981.

## DISCUSSION

Since its introduction in 1976, CAPD has stimulated a great enthusiasm among nephrologists as an alternative to haemodialysis<sup>5,6,11,13</sup>. This interest stemmed from the technical simplicity of CAPD which facilitates the development of home dialysis and from the continuous action of this technique which results in a dialysis at equilibrium with a better control of blood chemistries and a lesser need for dietary restrictions<sup>5</sup>.

In general terms the results obtained with CAPD in our patients were similar to those of other series: the signs and symptoms of uremia were corrected, blood pressure control was adequate<sup>14</sup>, anaemia was corrected in many patients and malnutrition was exceptional. It also showed that the frequency of peritonitis is much

TABLE V

MORBIDITY AND CAUSES OF HOSPITALISATION IN 99 PATIENTS FOLLOWED UP FROM 1ST SEPTEMBER 1980 TO FEBRUARY 1982

	Days in hospital/year
Intercurrent disease (mainly cardiovascular)	16.3
Peritonitis	13.4
ECV overload	3.5
Social problem	1.4
Peritonitis prophylaxis (peritoneal lavage)	1.1
Technical problem	0.2
<b>TOTAL DAYS/YEAR</b>	<b>35.8</b>

NEW PATIENTS ADMITTED ON PD EACH YEAR

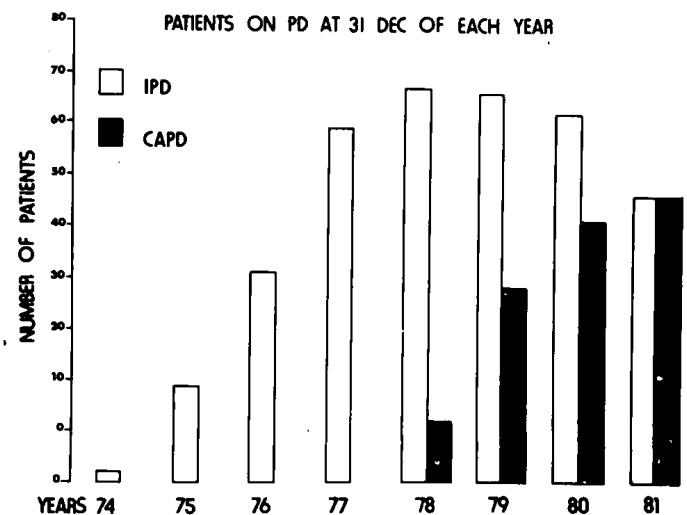
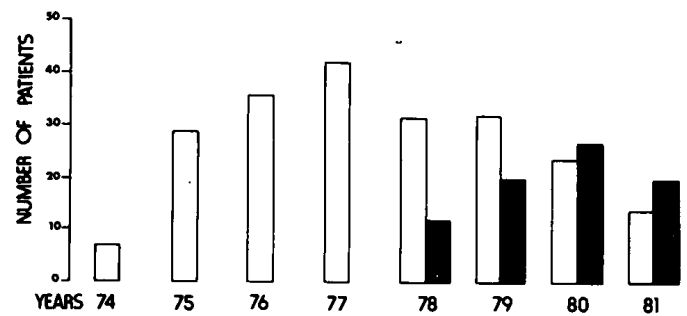


Fig. 5.—Compared development of intermittent peritoneal dialysis (IPD) and continuous ambulatory peritoneal dialysis (CAPD) from 1974 to 1981 in Languedoc-Roussillon.

TABLE VI  
CAUSES OF DEATH

	Number of patients	Percent death
1. Cardiovascular accidents	17	48.6
• Cerebrovascular accident	5	
• Sudden death	5	
• Congestive cardiac failure	2	
• Lower limb arteritis	2	
• Myocardial infarction	1	
• Cardiac arrhythmias	1	
• Mesenteric infarction	1	
2. Acute abdomen	6	17.0
• Peritonitis	4	
• Pancreatitis	1	
• Bowel perforation	1	
3. Visceral cancer	6	17.0
4. Treatment discontinued	3	8.6
5. Other	3	8.6
<b>TOTAL</b>	<b>35</b>	

higher in CAPD than in IPD with a peritonitis incidence of 1 episode every 1.6 patient treatment year. However, this peritoneal infection rate remains the lowest

ever reported in a large group of CAPD patients observed over a long period of time. These results emphasize the value of the microbiological filter in preventing peritonitis in CAPD.

The method of life table analysis used in calculating the risk of having a peritonitis, as proposed by D'APICE and ATKINS<sup>15</sup> and by PIERRATOS et al.<sup>16</sup>, confirms the fiability of our connecting device, as the percent risk of having a first episode of peritonitis remains the same (or decreases slightly) over a period of 3 years (fig. 5). Improvement in design and quality of our connecting device including its connectors should obtain a clear decrease in peritonitis incidence as 25 % of the observed peritonitis episodes occurred as a consequence of an accidental opening of the dialysate circuit at the site of connection with the Tenckhoff catheter or at the fitting of the plastic tubing with the microbiological filter.

The present data confirm our previous observation that there is a high incidence of drop out among the patients admitted on CAPD. The loss of the capacity to ultrafiltrate of the peritoneum was the main reason for transferring patients to IPD or HD. The high incidence of this abnormality was also confirmed in IPD patients and seemed mainly related to the duration of maintenance PD<sup>17</sup>. As the loss of peritoneal UF capacity was seldom reported in other long term series<sup>11,12</sup>, one might speculate that this phenomenon was related to some particularity of our technique, perhaps the use of dialysate solutions containing acetate instead of lactate as a buffer; however, this hypothesis has still to be confirmed.

Whatever the final answer to this puzzling observation, our experience underscores the need for integrating CAPD with other modes of maintenance dialysis<sup>2</sup>. Clearly, CAPD cannot be used as the only mode of therapy in an ESRD treatment programme: the availability of adequate facilities of HD and/or IPD is an absolute requirement to ensure long term patient survival.

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