

Organizational aspects of continuous ambulatory peritoneal dialysis (CAPD)

Martin J. Schreiber, M.D.
Donald G. Vidt, M.D.

Department of Hypertension and Nephrology

The treatment of end-stage renal disease (ESRD) with peritoneal dialysis has entered a new era with the development of continuous ambulatory peritoneal dialysis (CAPD). Since the initial description of this continuous internal dialysis procedure by Popovich et al,¹ it has fulfilled early expectations and continues to generate enthusiasm in the treatment of ESRD. Our early experience with CAPD has reinforced the previously reported views of Oreopoulos² calling for involvement of a well-organized and experienced medical-care team in the evaluation, initiation of treatment, and long-term follow-up of patients on CAPD. Only through a program addressing total needs in evaluation, training, and follow-up of patients will CAPD mature and become a viable alternative to other forms of dialysis. We describe the organizational philosophy and current approach to CAPD at The Cleveland Clinic Foundation.

The organizational framework for CAPD focuses on a number of essential steps in evaluating and training patients for this program. The "essential core" for our program is a dedicated team approach generating a thorough initial evaluation for selection, support during the training period, and continued interest in the needs of the patient after completion of the program. The primary structure

of the CAPD program at the Cleveland Clinic is shown in the *Figure*.

Selection of patients

During the initial phase of our CAPD program, an effort was made to consider primarily patients doing poorly on the present form of dialysis, i.e., in-center or home hemodialysis or intermittent peritoneal dialysis (IPD). As our experience has increased we are considering CAPD as a viable alternative form of treatment for patients requiring dialysis.

The present program is organized to receive referrals when a patient expresses an interest in CAPD or a physician believes a particular patient would be a candidate for CAPD. An attempt is then made to acquaint the patient with the CAPD procedure through informative discussions with the training staff via telephone and in person. Following this, interviews are scheduled with each member of the selection committee on the same day if feasible. The purpose of the multifaceted approach to selection of patients acknowledges the need for addressing total needs of the patient in deciding whether CAPD would be the optimal form of dialysis. There is no universal treatment modality for ESRD at present. The medical, social, and psychiatric needs in assessing treatment alternatives should be considered for each patient.

The selection committee must have a genuine interest in a patient's expectations regarding CAPD, his understanding of the disadvantages and advantages of CAPD, how the present form of dialysis is being tolerated if the patient is already in a dialysis program, and also whether there are any occupational rehabilitation goals the patient would like to pursue with the potentially increased mobility on CAPD. For those patients presently not on dialysis, but in need of dialysis in the near future, the same schedule for selection interviews applies.

Patients with previously reported contraindications to CAPD,³ which include familial hypertriglyceridemia, pain from lumbar disc disease, abdominal hernia, and colostomy, should be encouraged to pursue an alternative treatment other than CAPD. The wide scope of the selection committee allows for an additional quality in patient evaluation, i.e., motivational and medical compliance characteristics of persons with chronic disease. This quality is extremely important in any patient with a chronic disease on an independent treatment program.

Pre-CAPD training period

Upon completion of the evaluation, the patient is either accepted or advised not to enter the program for reasons agreed upon by the selection committee.

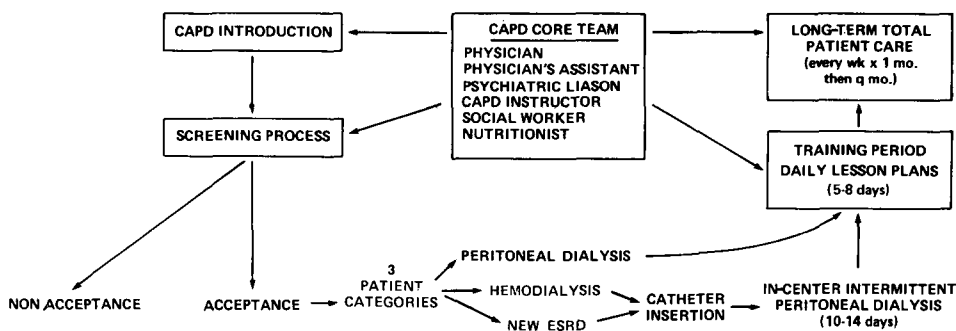


Figure. Primary structure of CAPD at The Cleveland Clinic Foundation.

After committee approval, the training period is planned, provided the patient has already been on peritoneal dialysis with a well-functioning silastic catheter.

If the individual has been on hemodialysis or is just beginning dialysis, a brief hospital admission is scheduled for catheter placement. Because of the simplicity of insertion and continued feasibility for repositioning if needed, the single-cuff Tenckhoff catheter has been used in our IPD patients. The bedside insertion of this catheter through a trocar has been less invasive than surgical placement in the operating room. We have had remarkable success with this type of bedside insertion and with the single catheter cuff. The overall longevity of the catheter life-span appears to equal that of those catheters placed under surgical visualization whether they be single- or double-cuff peritoneal catheters. The theoretical advantage, however, of the double-cuff catheter is its potential as a better barrier against peritonitis from skin infections with the catheter track as the actual path of entry. We are using both the single-cuff placement at the bedside and the surgical placement of double-cuff catheters in the patients on CAPD in an attempt to determine whether there is a benefit for selecting one over the other.

After observing dialysate leakage around a freshly inserted catheter with the 2-L continuous dwells on CAPD, we decided to place any new patient on in-center IPD for 10 to 24 days after catheter insertion. This would be done before starting a patient on CAPD. In a number of institutions brief dwell periods are used with 1-L exchanges while employing the CAPD technique. This, however, requires an increased amount of nursing time as well as exposing the patient to a constant amount of fluid over a prolonged period. Although there

is less distension with the decreased dwell amount, there is still some concern regarding the potential of catheter exit skin breakdown and fluid leakage early in the healing period following catheter placement. In essence, the leakage of fluid once starting CAPD immediately after catheter insertion may delay effective healing and also increase the potential for cellulitis and subsequent peritonitis.

During IPD, the patient is instructed in aseptic technique, spike bag insertion, and hand-washing technique before the first day of the CAPD training. Although the long-term use of prophylactic antibiotics is discouraged due to the development of resistant organisms, a short course of prophylactic cephalosporins during the peri-insertion period is occasionally utilized if difficulties are experienced with catheter placement or if manipulation of a recently inserted catheter is required to overcome drainage problems. Long-term studies with larger populations are indicated before definitive conclusions regarding prophylactic antibiotics can be definitely made. IPD also enables a gradual increase of dwell fluid volume if less than 2 L is tolerated by the patient initially.

CAPD training

The actual CAPD training is performed by a nurse or a physician's assistant instructor based on the procedure developed from modifications of the techniques of both Popovich et al¹ and Oreopoulos.² We have developed a lesson plan attempting to give the patient daily goals. The CAPD training period averages from 5 to 8 days depending on how a patient progresses. Besides the actual technique, the patient is also instructed in managing emergency situations, e.g., disconnection, the inability to infuse or drain dialysate

spike contamination, recognizing the early warning signs of peritonitis, and the correct procedure for culturing and adding antibiotics to the dialysate bag if needed. The training can usually be completed in a relatively short period of time compared with time required for home training for peritoneal dialysis or hemodialysis. However, longer sessions may be necessary for some patients; the most important point is that the patients consistently demonstrate proper technique and feel confident that they can perform the exchanges independently. Patients within the local area can return home daily while in training. Hospitalization is more practical if a patient is from out of town and should be especially considered for a diabetic patient who is attempting to achieve optimal blood glucose control despite the increased glucose load with the dialysate fluid.

During the training period, patients undergo a nutritional assessment that proves invaluable for regulating protein intake to compensate for losses in the dialysate fluid, need for phosphorus restriction, and the monitoring of ideal body weight on CAPD. Baseline chemistry studies are obtained routinely along with CAPD solute clearances.

Long-term care

After patients have completed the training program, follow-up is done by telephone by the training nurse or physician's assistant instructor twice a week during the first month. Machine dependence of dialysis patients has in general hindered their sense of independence and self-confidence. In view of this, we slowly attempt to let their self-confidence mature wherein they can function comfortably in an independent home environment without the social-

izing aspect of in-center personal contacts of "machine umbilicalization."

CAPD patients are seen weekly in the out-patient department during the initial month; laboratory values are routinely checked and cultures obtained of the dialysate fluid. Because a significant percentage of peritonitis in this population occurs during the initial 3 months, it is essential that peritoneal cultures and white blood cell counts be done judiciously. After the initial month, the patients return to the outpatient department monthly for clearance calculations, tubing changes, dialysate drainage cultures, routine laboratory studies, and physical examinations.

The medical reasons for interruption of CAPD after entry into the program are bowel complications (e.g., ulcer perforation, perforated viscus), loss of ultrafiltration capacity determined through decreasing clearances, more than three episodes of peritonitis over a 2-month period, medically uncontrollable hypertriglyceridemia, intermittent vascular occlusions secondary to peritoneal dialysate compression of arterial blood supply, uncontrolled depression despite psychiatric efforts, development of symptomatic lumbar disc disease, and medical noncompliance.

Additional specific prerequisites

It is essential that a physician be on call at all times and that an organized system for receiving telephone calls from CAPD patients be available received either by in-center peritoneal dialysis personnel who function as CAPD instructors or by a specific CAPD answering service. Calls are then directed to the appropriate member of the "CAPD Core Team." There should also be arrangements made whereby situations warranting emergency alternative forms

of dialysis can be dealt with promptly if a CAPD patient has a problem.

Because of the overriding concern about peritonitis in this population, a specific protocol must be developed in each center for the successful management of peritonitis. This includes early recognition, obtaining appropriate cultures, and prompt therapy. Presently we are employing a modified peritonitis protocol adapted from that shown in *Table 1*. We hope that through early recognition and prompt treatment there will be less long-term damage to the diffusion characteristics of the peritoneal membrane following peritonitis. Guidelines for treatment are listed in *Table 2*.

The overall yield from Gram's stains of peritoneal fluid has never been favorable for patients on IPD. We suspect that this approach will not change dramatically in our CAPD population. The recent report by Rubin et al⁴ supports this impression wherein approximately 10% of Gram's stains were positive in cases of actual culture-proved peritonitis. Through the centrifugation of approximately 50 to 100 ml of dialysate fluid, the Gram's stain yield might be improved. Only through the judicious use of peritoneal fluid cultures before the initiation of broad spectrum antibiotics (tobramycin plus cephalosporin), can one change to a more specific antibiotic based on initial culture growth. Presently, we assess cultures and change to specific therapy in 24 to 48 hours, and then treat for 10 days incorporating intraperitoneal antibiotics. Before discontinuing the use of antibiotics we require three consecutive negative peritoneal cultures. Also a culture is obtained 7 days after completion of therapy for assurance that the organism has been eradicated.

CAPD and the diabetic patient

We are encouraged by our initial experience with the diabetic patient on CAPD provided the degree of retinopathy is not a contraindication to perform adequately the procedure when the patient lives alone or decides to dialyze by himself. However, two of our patients with considerable retinopathy are being aided in their exchanges by their spouses. The question of the progression of retinopathy and relationship of the improved middle molecule clearance and the possible effect on neuropathy are still unanswered. We have been able to achieve stable control of blood glucose levels through the use of both subcutaneous and intraperitoneal insulin. Recently, most of the treatment of our diabetic patients has been changed to total intraperitoneal insulin with equally good control of blood glucose levels.

Transplantation

Patients desiring kidney transplantation can be entered into a CAPD program. Although the initial numbers are small, it is apparent that patients can undergo transplantation without any undue side effects from CAPD. We have performed transplantation in patients who have been off IPD for several years without an increased incidence of complications.⁵

However, if transplantation is anticipated within 6 months, based on the patient's blood group and histocompatibility antigen along with kidney donor availability, one must balance the risk of peritonitis within the respective center with the desire to pursue CAPD. Because most kidney transplantation procedures involve the retroperitoneal space, peritoneal dialysis is a viable alternative if needed postoperatively in

Table 1. CAPD peritonitis protocol

Initial patient presentation	Group I		Group I Discontinue treatment after 48 hr if cultures remain (-) and symptoms resolve	
	Group II			
	Symptoms (+)	Culture dialysate drainage† Begin antibiotics‡ Observe cultures, reassess after 24 hr	Group II Change to specific antibiotics if culture (+)	
	Dialysate drainage (+)*			
	Gram's stain (-)			
	Cell count <300/mm ³			
	Symptoms (+)			
	Dialysate drainage (++)			
	Group III		Group III Continue specific antibiotics pending organism identification and sensitivities	
	Gram's stain (-)			
	Cell count >300/mm ³			
	Symptoms (++)			
	Dialysate drainage (++)			
	Gram's stain (+)			
	Cell count >300/mm ³			

* Dialysate drainage cloudy, proteinaceous.
† Obtain cultures for aerobic, anaerobic, fungal, acid-fast. If cultures remain negative despite persistent symptoms and/or cloudy fluid, a filter culture technique as previously outlined⁴ should be employed to increase dialysate culture yield.
‡ Groups I and II, broad spectrum (cephalosporin and aminoglycoside); Group I, specific antibiotic. Adapted from Nolph KD, Sorkin MI. International Symposium on CAPD, Austin, Texas, May 9 and 10, 1980.

Table 2. Guidelines for treatment of peritonitis

Incorporate intraperitoneal antibiotics (cephalosporin, 125 mg/L; tobramycin, 5 mg/L during the initial 48 hours, perform 4-hour dwell periods.
Have patient return to regular schedule, three to five exchanges every day, in 48 hours if symptoms improve.
Continue treatment for 10 to 14 days and obtain three negative dialysate cultures before antibiotics are discontinued.
If symptoms persist longer than 48 hours, consider hospitalization for IPD with 30-minute dwell periods.
When symptoms and/or positive cultures persist after 5 to 7 days, removal of catheter should be considered.

this group. With this in mind, CAPD can be used if necessary.

We do not encourage patients with a prospective living related donor to enter a CAPD program or change from their present mode of dialysis before transplantation if transplantation is planned for the immediate future. If a patient who may be a candidate for transplantation within 4 to 6 months still desires CAPD, the best approach, considering the incidence of peritonitis, might be the use of prophylactic cephalosporins during the interim. Until more experience is gained in transplantation for patients on CAPD, conclusions regarding this form of dialysis and transplantation are subject to change.

Conclusion

The basic principle behind CAPD is simplicity, mobility, and improved total weekly peritoneal dialysis. As experience with this form of dialysis increases, the overall applicability of CAPD should continue to expand. It is essential that a program be well organized, with thorough training and long-term total

patient care provided by essential medical personnel. Our early experience with CAPD has been encouraging. CAPD has a far-reaching potential as an alternative to hemodialysis, transplantation, and IPD for the patient with ESRD.

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