Modification of the Percutaneous Approach to Peritoneal Dialysis Catheter Placement Under Peritoneoscopic Visualization: Clinical Results in 78 Patients

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ABSTRACT
The placement of percutaneous peritoneal dialysis catheters under direct peritoneoscopic visualization is a relatively new technique for establishing peritoneal dialysis access. In this study, in which a modification of the Seldinger technique was used to facilitate the placement of the peritoneoscope, the experience with 82 consecutive catheterization procedures in 78 patients is reported. In 2 (2.4%) of 82 catheterization procedures, we were unable to enter the peritoneal cavity but experienced no other complications unique to the percutaneous approach. Of the 80 successful catheterization procedures, 76 represented first-time catheter placement and constituted a population subjected to life-table analysis examining catheter survival rates, the time to first cutaneous exit site or s.c. tunnel infection, and the time to first episode of peritonitis. After a follow-up period of 50.1 patient yr, 11 catheters were lost because of catheter dysfunction. Other clinical complications included peritoneal fluid leaks at the cutaneous exit site in 11 instances (0.22/patient yr), cutaneous exit site infection in 7 instances (0.14/patient yr), s.c. tunnel infection in 2 instances (0.04/patient yr), and 34 episodes of peritonitis (0.68/patient yr). The results of this study demonstrate that the suggested modification of the percutaneous placement of peritoneal dialysis catheters, under peritoneoscopic visualization, is a viable method for establishing peritoneal access.

Key Words: Continuous ambulatory peritoneal dialysis, Tenckhoff catheter, peritoneal cannulation, Seldinger technique

Peritoneal dialysis has now become an accepted mode of renal replacement therapy (1). Peritoneal dialysis catheters may be placed by three methods: (1) under direct surgical vision (2), (2) by the nonvisualized, percutaneous method of Tenckhoff and Schechter (3), or (3) by the percutaneous method of Ash et al. (4) with a peritoneoscope to visualize the peritoneal cavity. In the latter two techniques, the peritoneal cavity is percutaneously entered with the inherent risk of viscus or blood vessel perforation. In an attempt to minimize such risks, the method of Ash et al. was modified by using the Seldinger technique to enter the peritoneal cavity. This study investigated the clinical utility of this new approach in establishing access for peritoneal dialysis.

METHODS

Patients and Clinical Parameters Studied
The medical records of 78 consecutive patients who underwent peritoneoscopic placement of one or more peritoneal dialysis catheters at The Ohio State University from January 1988 to May 1990 were reviewed. The underlying cause of renal insufficiency and the clinical status of each patient at the end of the study period were documented.

Catheter loss was defined as a dysfunctional catheter and resulted from four causes: (1) peritoneal fluid leaks around the cutaneous exit site, (2) inade-
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quate peritoneal dialysate flow, (3) cutaneous exit site infection, or (4) catheter erosion of a viscus.

Clinical complications from infection included cutaneous exit site or s.c. tunnel infection, defined as a painful cutaneous exit site and/or s.c. tunnel with purulent discharge and positive cultures, or peritonitis, defined as the presence of clinical symptoms, elevated peritoneal dialysis fluid white blood cell count (100 white blood cells/μL with >50% neutrophils), and positive peritoneal dialysis fluid cultures.

Technical Considerations

In the studies presented here, peritoneal dialysis access was established by the percutaneous placement of a straight, double-cuffed Tenckhoff catheter. Catheter placement was facilitated by direct visualization of the peritoneal cavity with a peritoneoscope (Y-TEC®; Medigroup, Inc, North Aurora, IL). The method of Ash et al. (4) was modified by using the Seldinger technique to simplify access to the peritoneal cavity before the placement of the peritoneoscope.

In preparation for the procedure and under sterile conditions, the bevel of a 6-inch, 14-gauge angiocatheter was rounded (Figure 1A; insert) both to enhance operator sensitivity when the angiocatheter was passed into the peritoneal cavity and to minimize the risk of bowel perforation. The specific modifications of the procedure are described as follows: (1) instead of using the Y-TEC cannula and trochar, the blunted angiocatheter was used to enter the peritoneal cavity (Figure 1A); (2) after microfilter-sterilized (Millipore, Bedford, MA) room air was insufflated, the angiocatheter was removed over a flexible guidewire; (3) the Y-TEC cannula, with surrounding Quill® catheter guide (Medigroup, Inc) for the peritoneoscopic needle, was cannulated with a 7 French vascular catheter dilator and this assembly was advanced over the guidewire into the peritoneal cavity (Figure 1B); and

Figure 1. Technical considerations (see Text for details). (A) The tip of a 6-inch, 14-gauge angiocatheter is dulled (insert), and the catheter is used to enter the peritoneal cavity. (B) The peritoneoscopic guide, precannulated with a 7 French vascular catheter dilator, is advanced over a flexible guidewire. (C) Peritoneoscopic visualization of the peritoneal cavity.
(4) the removal of the dilator and guidewire permitted
the peritoneoscope to be passed through the perito-
neoscopic guide to visualize the peritoneal cavity (Fig-
ure 1C). The remainder of the procedure is essentially
as has been previously reported (4), with the excep-
tion that we make no effort to place the proximal cuff
of the catheter within the deep musculature, but
rather fix it to the fascia of the rectus sheath with
s.c. sutures.

Data Analysis

Survival curves for catheter survival, for time to
first cutaneous exit site or s.c. tunnel infection and
for time to first episode of peritonitis, were calculated
by Kaplan-Meier analysis.

RESULTS

Patient Characteristics and Technical
Considerations

In this study, 78 patients underwent 82 percu-
taneous catheterization procedures. Sixty-one percent
of the patients were men with a mean age of 57 yr
(range, 22 to 84). The underlying causes of renal
insufficiency are depicted in Table 1, and the clinical
outcome at the end of the study period is shown in
Table 2.

The peritoneal cavity was successfully cannulated
in 80 (97.6%) of 82 catheterization procedures. The
inability to enter the peritoneal cavity in two patients
constituted the one complication that was unique to
the percutaneous method. In both of these patients,
the abdominal wall muscular tone was lax because
decreased rectus muscle mass. Under these condi-
tions, the resistance to the penetration of the an-
giocatheter was so low that the operators could not
determine when the peritoneal cavity had been
entered. In both patients, several unsuccessful at-
ttempts to enter the peritoneal cavity were made
through the original incision. When those cannula-
tions failed, the procedure was abandoned and the

<table>
<thead>
<tr>
<th>TABLE 1. Causes of renal failure in patients undergoing percutaneous peritoneal catheter placement</th>
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<tbody>
<tr>
<td>Causes of Renal Failure</td>
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<tr>
<td>Diabetes Mellitus</td>
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<td>Glomerulonephritis</td>
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<td>Nephrosclerosis</td>
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<td>Interstitial Nephritis</td>
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<td>Polycystic Kidney Disease</td>
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<tr>
<td>Miscellaneous</td>
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patients were referred for surgical catheter place-
ment.

Of the 80 successful catheterization procedures,
76 were first-time catheter placements for a total
follow-up time of 50.1 patient yr.

Causes of Catheter Loss

A total of 11 (14.5%) of 76 catheters were lost
because of catheter dysfunction. These losses re-
sulted from peritoneal fluid leaks at the cutaneous
exit site (four catheters), poor dialysate flow (five
catheters), cutaneous exit site infection (one cathe-
ter), and a surgically confirmed iliac erosion leading
to perforation 2.7 months after catheter placement
(one catheter).

Complications

Complications included peritoneal fluid leaks
around the catheter at the cutaneous exit site in 11
instances (0.22/patient yr), 7 cutaneous exit site in-
fecions (0.13/patient yr), 2 tunnel infections (0.03/
patient yr), and 34 episodes of peritonitis (0.67/pat-
ient yr).

DISCUSSION

The results of this study demonstrate that modifi-
cation of the Seldinger technique can be successfully
employed to facilitate the peritoneoscopic placement
of peritoneal dialysis catheters. The use of a percu-
taneously placed peritoneal catheter was first de-
scribed by Tenckhoff and Schechter in 1968 (3).
Peritoneal access was established by the introduction
of a peritoneal catheter through a large-bore trochar.
This method may still be employed for bedside access
of the peritoneal cavity for peritoneal dialysis (2). In
1981, Ash et al. described the placement of a Tenck-
hoff peritoneal dialysis catheter with the Y-TEC 2.2-
mm peritoneoscope (4). In a subsequent report (5),
this method was used for the placement of 98 peritoneal dialysis catheters and further demonstrated that the procedure was an effective mode for establishing peritoneal access.

The study presented here used a modification of the Seldinger technique to facilitate peritoneal dialysis catheter placement under peritoneoscopic visualization. At our institution, the advantage of using the described modifications was realized in terms of operator comfort when cannulating the peritoneal cavity. In addition, we would theorize that the proposed modifications may offer a decreased risk of viscous perforation for the following reasons: (1) dulling the tip of the angiocatheter increases operator sensitivity and thus decreases the risk of inadvertent bowel perforation and (2) using the Seldinger technique to enter the peritoneal cavity allows for a more controlled introduction of large-bore needles and cannu.lae.

The risk of bowel perforation after nonvisualized peritoneal cannulation ranges from 1.3 to over 2.5% [6,7]. In contrast, bowel perforation did not occur after the placement of 681 catheters by the unmodified technique (4, 5, 8–11) or in the studies presented here, where 80 catheters were successfully placed using a modification of the Seldinger technique to enter the peritoneal cavity. Taken together, these data (encompassing 761 catheters) suggest that catheter placement under direct visualization may have a lower incidence of bowel perforation than blind catheter placement. It is unknown if the modifications described in this series will confer an additional margin of safety in preventing bowel perforation.

In the studies presented here, we used the described method for the placement of only straight, double-cuffed, Tenckhoff peritoneal dialysis catheters. In contrast, the unmodified percutaneous approach, with peritoneoscopic guidance, has been used for the placement of straight (4,5,8,9), coiled (9,10), and Swan-neck (personal communication, Accurate Surgical Instruments, Corp., Toronto, Ontario, Canada) Tenckhoff catheters as well as coiled Cruz catheters (Corpak, Inc., Wheeling, IL) (11).

A unique complication of the percutaneous approach would be the inability to enter the peritoneal cavity. In this series, this complication occurred in 2.4% of catheterization attempts, appeared to be more common in patients with a lax rectus musculature, and necessitated catheter placement under direct surgical visualization.

Life-table analysis (Figure 2) for catheter survival, time to first episode of cutaneous exit site or s.c. tunnel infection, and time to first episode of peritonitis demonstrated curves comparable to those reported by the National CAPD registry (12) and a subsequent report examining the survival of surgically placed Swan-neck catheters (13). Although a direct

Figure 2. Life-table analysis of catheter survival (open squares) time to first cutaneous exit site infection (closed squares), or time to first episode of peritonitis (open circles). The number of catheters at each time point that were at risk for the clinical event were, for catheter survival, 76, 49, 35, 20, 11, and 5; for time to first exit site infection, 76, 49, 33, 19, 11 and 5; and for time to first episode of peritonitis, 76, 45, 30, 15, 7 and 2.

comparison is not possible, we believe the data suggest that the procedure presented here represents an acceptable approach for establishing peritoneal access.

In summary, the percutaneous placement of peritoneal dialysis catheters, by a variation of the Seldinger technique and peritoneoscopic guidance, is a viable mode of establishing peritoneal access for peritoneal dialysis. Defining whether this procedure confers any clinical advantages over catheters placed under direct surgical visualization will require a randomized, prospective clinical trial.

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REFERENCES