Outcome of Immediate Use of the Permanent Peritoneal Dialysis Catheter in Children with Acute and Chronic Renal Failure

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Abstract

Objective: Peritoneal dialysis remains the only available option for patients which need immediate dialysis and it could be a bridge between end-stage renal failure (ESRD) and transplantation. There is a paucity of published experience of children with immediate use of permanent Tenckhoff catheter for peritoneal dialysis from developing countries. In this study we report our experience on immediate use of permanent peritoneal access and continued peritoneal dialysis for a prolonged time.

Methods: Fifty six patients were studied including 30 males and 26 females within the age range of 1 month to 14 years with mean age of 6.5 years in Urmia, Northwest Iran.

Findings: No operative morbidity was seen. During a total of 499.5 continuous ambulatory peritoneal dialysis months, 16 patients had 28 episodes of peritonitis, which means a overall result of one episode per 17.8 months. There were 3 patients (5.35%) with catheter site leakage, 12 (21.4%) catheter obstructions (which led to omentectomy), 4 (7.2%) exit site infections (2 patients in the early postoperative period and 2 patients during follow up). Death due to catheter related complications occurred in 1 per 56 patients and due to non-catheter related causes in 10 per 56 patients.

Conclusion: Present results indicate that catheter-related complications were not higher than those previously reported and peritoneal dialysis could be initiated immediately after catheter implantation and could be a safe bridge between end-stage renal failure (ESRD) and transplantation.

Key Words: Peritoneal Dialysis; End-Stage Renal Failure; Complications; Peritonitis

Introduction

The choice of modality of renal replacement treatment in children with renal failure is a challenge. Although extracorporeal techniques such as continuous venovenous hemofiltration (CVVH) or continuous venovenous hemodiafiltration (CVVHDF) are used quite frequently in adult intensive care units (ICUs), but it is not a common modality of renal replacement treatment in many pediatric ICUs. Such techniques are very dependent on technology and are more costly than acute peritoneal dialysis (PD). However, in developing countries, acute PD remains a viable option for the treatment of children with renal failure, particularly in patients with hemodynamical compromise, severe coagulation abnormalities and difficulty in obtaining vascular access.

Because of vascular access problem in children with acute renal failure (ARF) and those with ARF superimposed on chronic condition, especially when there is need for urgent dialysis which may last for more than a few days, it is important to...
start immediately and continue PD with a permanent peritoneal access. In most pediatric and adult PD centers because of catheter-related PD complications, dialysis begins after catheter has been implanted and sufficient time for healing has been allowed\cite{5-7}. However, catheter-related PD complications such as peritonitis, exit-site infection (ESI), tunnel infection, pericatheter leakage, and mechanical dysfunction are still major concerns\cite{6,8}. There is a paucity of published experience on children with immediate use of permanent Tenckhoff Catheter for PD from developing countries. In this article we report our experience on immediate use of permanent peritoneal access and continued PD for a prolonged time.

Subjects and Methods

Data collection: Fifty six children with end stage renal failure and acute renal failure from 2005 to 2011 which needed PD, immediately after catheter insertion was included. Patients were included if there was a need for emergency dialysis (which was expected that it lasts for days and weeks) because of acute renal failure or acute condition on chronic renal failure. Exclusion criteria were children less than 1 month and more than 14 years old, patients who did not have an emergent dialysis, patients who were under PD less than 3 weeks. The information on patients was obtained from the files of the hospital’s pediatrics ward – if they were hospitalized or in records available from follow up visits.

Catheter insertion method: Swan neck coil 2 cuff pediatric catheter was selected. After induction of general anesthesia and gastric decompression, the patient was placed in a supine position. A 10 mm incision was made left side 2 cm inferior to umbilicus, loop of the catheter was placed in the pelvic and after closing peritoneum and fascia a 10 cm subcutaneous tunnel was formed. The peritoneal cavity was flushed with 10 ml/Kg of PD solution to check for gross bleeding or leakage. PD started immediately after finishing the operation. The patients were kept at bed rest for 72 hours.

Dialysis method: We used 10 cc/Kg dialysis fluid with dwell time of 15-30 min for 3 days; during next days volume of the fluid gradually increased up to 40cc/kg. After two weeks, dialysis was performed with 40cc/kg with dwell time of about 3 hours, 5– 6 times a day.

Antibiotics and medication: Antibiotics were applied for 72 hours after operation. The regular use of Mupirocin ointment at the exit site, intraperitoneal prophylactic antibiotics (cephalexin 125mg/l of dialysis fluid) and intraperitoneal heparin (500 IU/l of dialysis fluid) was practiced in all patients.

Follow up: Peritoneal fluid analyzes and microbial cultures were applied and patients were observed for complications during hospitalization. After discharge patients were visited every other week for 1 month and every month later on. All patients were operated by the same surgeon and the biochemical tests and analyses carried out in the same laboratory.

Data analysis: Outcomes were analyzed in terms of peritonitis, ESI, tunnel infection (TI), pericatheter leakage, mechanical dysfunction, renal transplantation and mortality and changing to hemodialysis. ESI, TI and peritonitis were defined according to the International Society for PD guidelines/recommendations\cite{9}. Peritonitis was defined as positive peritoneal fluid culture or if two of four of the following signs were present: abdominal pain, fever, cloudy peritoneal effluent, white blood cell count (at least 50% polymorphonuclear leukocytes) greater than 100/ml in dialysis fluid. ESI was diagnosed in the presence of purulent discharge from the sinus tract, or marked pericatheter swelling, redness, and/or tenderness with or without a pathogenic organism cultured from the exit site; TI was defined as presence of pain and signs of inflammation along the subcutaneous tunnel.

Findings

Fifty six patients were studied including 30 males (53.6%) and 26 females (46.4%) within the age range of 1 month to 14 years with mean age of 6.5 years. The body mass index (BMI) of patients were calculated with WHO BMI charts for pediatrics\cite{10}, BMI less than 3 percentile found in 30.2% patients, 53.2% had BMI between 3 and 9...
percentile and 16.3% had BMI more than 97 percentile.

No operative morbidity was seen. During a total of 499.5 continuous ambulatory PD (CAPD) months, 16 patients had 28 episodes of peritonitis; which means one episode per 17.8 months. There were 3 (5.35%) cases of catheter site leakage, 12 (21.4%) catheter obstructions (which led to omentectomy), 4 (7.2%) ESI (2 in the early postoperative period and 2 during follow up) (Table 1). The rate of ESI and pericatheter leakage was relatively low. Leakage stopped in all of patients with decreasing the number and volume of dialysis fluid. The rate of early onset obstruction in patients without omentectomy at the time of insertion of catheter was high. None of the patients with omentectomy had at the time of insertion of catheter obstruction.

The death due to catheter related complications were 1 per 56 patients and death due to non-catheter related causes was 10 per 56 patients (Table 2). Four deaths occurred among 21 children with acute renal failure and 7 among 35 children with chronic renal failure (Table 3, 4).

Table 1: Incidence of early and late catheter related complications in patients on CAPD (n=56)

<table>
<thead>
<tr>
<th>Complication</th>
<th>Early onset &lt;1 month</th>
<th>Late onset &gt;1 month</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstruction</td>
<td>11 (19.6%)</td>
<td>1 (1.8%)</td>
<td>12 (21.4%)</td>
</tr>
<tr>
<td>Leak</td>
<td>2 (3.57%)</td>
<td>1 (1.78%)</td>
<td>3 (5.35%)</td>
</tr>
<tr>
<td>Exit site infection</td>
<td>2 (3.6%)</td>
<td>2 (3.6%)</td>
<td>4 (7.2%)</td>
</tr>
<tr>
<td>Tunnel infection</td>
<td>1 (1.8%)</td>
<td>0</td>
<td>1 (1.8%)</td>
</tr>
<tr>
<td>Peritonitis*</td>
<td>3 (5%)</td>
<td>13 (23%)</td>
<td>16 (28%)</td>
</tr>
</tbody>
</table>

* The incidence of peritonitis is one episodes/17.8 months. CAPD: continuous ambulatory peritoneal dialysis

Table 2: Outcome of the immediate use of the permanent peritoneal dialysis catheter in children with end stage renal disease

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expired</td>
<td>11 (19.6)</td>
</tr>
<tr>
<td>Transplanted</td>
<td>15 (26.8)</td>
</tr>
<tr>
<td>Cured</td>
<td>15 (26.8)</td>
</tr>
<tr>
<td>Under peritoneal dialysis</td>
<td>12 (21.4)</td>
</tr>
<tr>
<td>Transfer to hemodialysis</td>
<td>3 (5.4)</td>
</tr>
<tr>
<td>Total</td>
<td>56 (100)</td>
</tr>
</tbody>
</table>

Table 3: Dialysis duration (month) and causes of acute renal failure

<table>
<thead>
<tr>
<th>Patients' ID</th>
<th>Age (year)</th>
<th>Condition</th>
<th>Sex</th>
<th>Dialysis duration (months)</th>
<th>Causes of acute renal failure (ARF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>cured</td>
<td>Male</td>
<td>1</td>
<td>Rhabdomyolysis</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>cured</td>
<td>Male</td>
<td>1</td>
<td>HUS</td>
</tr>
<tr>
<td>3</td>
<td>11</td>
<td>cured</td>
<td>Female</td>
<td>1</td>
<td>HUS</td>
</tr>
<tr>
<td>4</td>
<td>13</td>
<td>cured</td>
<td>Male</td>
<td>1</td>
<td>HUS</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>cured</td>
<td>Female</td>
<td>2.5</td>
<td>RPGN</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>cured</td>
<td>Female</td>
<td>2</td>
<td>HUS</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>cured</td>
<td>Female</td>
<td>1</td>
<td>HUS</td>
</tr>
<tr>
<td>8</td>
<td>&lt;1</td>
<td>cured</td>
<td>Male</td>
<td>1</td>
<td>Renal Vein Thrombosis</td>
</tr>
<tr>
<td>9</td>
<td>6</td>
<td>cured</td>
<td>Female</td>
<td>1</td>
<td>HUS</td>
</tr>
<tr>
<td>10</td>
<td>&lt;1</td>
<td>expire</td>
<td>Male</td>
<td>1</td>
<td>HUS</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>cured</td>
<td>Female</td>
<td>2</td>
<td>HUS</td>
</tr>
<tr>
<td>12</td>
<td>3</td>
<td>cured</td>
<td>Female</td>
<td>2</td>
<td>HUS</td>
</tr>
<tr>
<td>13</td>
<td>13</td>
<td>cured</td>
<td>Male</td>
<td>1.5</td>
<td>HUS</td>
</tr>
<tr>
<td>14</td>
<td>&lt;1</td>
<td>cured</td>
<td>Male</td>
<td>2</td>
<td>HUS</td>
</tr>
<tr>
<td>15</td>
<td>&lt;1</td>
<td>expire</td>
<td>Male</td>
<td>&lt;1</td>
<td>sepsis</td>
</tr>
<tr>
<td>16</td>
<td>3</td>
<td>cured</td>
<td>Female</td>
<td>1</td>
<td>HUS</td>
</tr>
<tr>
<td>17</td>
<td>5</td>
<td>expire</td>
<td>Male</td>
<td>&lt;1</td>
<td>HUS</td>
</tr>
<tr>
<td>18</td>
<td>4</td>
<td>cured</td>
<td>Male</td>
<td>1</td>
<td>HUS</td>
</tr>
<tr>
<td>19</td>
<td>8</td>
<td>cured</td>
<td>Female</td>
<td>2</td>
<td>HUS</td>
</tr>
<tr>
<td>20</td>
<td>14</td>
<td>cured</td>
<td>Male</td>
<td>1</td>
<td>Unknown</td>
</tr>
<tr>
<td>21</td>
<td>3</td>
<td>expire</td>
<td>Male</td>
<td>2</td>
<td>HUS</td>
</tr>
</tbody>
</table>

RPGN: Rapid progressive glomerulonephritis / HUS: Hemolytic uremic syndrome
Table 4: Dialysis duration (month) and causes of chronic renal failure

<table>
<thead>
<tr>
<th>Patients’ ID</th>
<th>Age (year)</th>
<th>Condition</th>
<th>Sex</th>
<th>Dialysis duration (months)</th>
<th>Causes of chronic renal failure (CRF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>Transplantation</td>
<td>Female</td>
<td>13</td>
<td>Neurologic bladder</td>
</tr>
<tr>
<td>2</td>
<td>11</td>
<td>Change to HD</td>
<td>Female</td>
<td>5</td>
<td>Reflux nephropathy</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Under CAPD</td>
<td>Female</td>
<td>15</td>
<td>Neurologic bladder</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>expired</td>
<td>Male</td>
<td>&lt;1</td>
<td>Posterior urethral valve</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>expired</td>
<td>Male</td>
<td>13</td>
<td>Cystinosis</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>Transplantation</td>
<td>Male</td>
<td>6</td>
<td>Unknown</td>
</tr>
<tr>
<td>7</td>
<td>&lt;1</td>
<td>expired</td>
<td>Male</td>
<td>1</td>
<td>Nephrocalcinosis</td>
</tr>
<tr>
<td>8</td>
<td>14</td>
<td>Under CAPD</td>
<td>Male</td>
<td>48</td>
<td>Neurologic bladder</td>
</tr>
<tr>
<td>9</td>
<td>5</td>
<td>Transplantation</td>
<td>Female</td>
<td>14</td>
<td>Glomerulonephritis</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>expired</td>
<td>Female</td>
<td>24</td>
<td>Reflux nephropathy</td>
</tr>
<tr>
<td>11</td>
<td>7</td>
<td>Under CAPD</td>
<td>Male</td>
<td>27</td>
<td>Neurologic bladder</td>
</tr>
<tr>
<td>12</td>
<td>5</td>
<td>Under CAPD</td>
<td>Male</td>
<td>24</td>
<td>Glomerulonephritis</td>
</tr>
<tr>
<td>13</td>
<td>5</td>
<td>Transplantation</td>
<td>Male</td>
<td>5</td>
<td>Reflux nephropathy</td>
</tr>
<tr>
<td>14</td>
<td>11</td>
<td>Under CAPD</td>
<td>Female</td>
<td>20</td>
<td>Unknown</td>
</tr>
<tr>
<td>15</td>
<td>9</td>
<td>Transplantation</td>
<td>Male</td>
<td>12</td>
<td>Nephronephritis</td>
</tr>
<tr>
<td>16</td>
<td>7</td>
<td>Transplantation</td>
<td>Male</td>
<td>12</td>
<td>Glomerulonephritis</td>
</tr>
<tr>
<td>17</td>
<td>1</td>
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<td>Female</td>
<td>10</td>
<td>Glomerulonephritis</td>
</tr>
<tr>
<td>18</td>
<td>9</td>
<td>Under CAPD</td>
<td>Male</td>
<td>10</td>
<td>Reflux nephropathy</td>
</tr>
<tr>
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<td>8</td>
<td>Transplantation</td>
<td>Female</td>
<td>6</td>
<td>Reflux nephropathy</td>
</tr>
<tr>
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<td>14</td>
<td>Under CAPD</td>
<td>Female</td>
<td>7</td>
<td>Glomerulonephritis</td>
</tr>
<tr>
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<td>Male</td>
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<td>Nephrolithias</td>
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<td>Hemolytic Uremic Syndrome</td>
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<td>20</td>
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</tr>
<tr>
<td>24</td>
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<td>Male</td>
<td>4</td>
<td>Cystinosis</td>
</tr>
<tr>
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<td>8</td>
<td>Transplantation</td>
<td>Female</td>
<td>3</td>
<td>Urogenital anomaly</td>
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<td>26</td>
<td>4</td>
<td>Change to HD</td>
<td>Female</td>
<td>1</td>
<td>Reflux nephropathy</td>
</tr>
<tr>
<td>27</td>
<td>7</td>
<td>Transplantation</td>
<td>Female</td>
<td>12</td>
<td>Hemolytic Uremic Syndrome</td>
</tr>
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<td>7</td>
<td>Transplantation</td>
<td>Female</td>
<td>38</td>
<td>Glomerulonephritis</td>
</tr>
<tr>
<td>29</td>
<td>4</td>
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<td>Male</td>
<td>15</td>
<td>Cystinosis</td>
</tr>
<tr>
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<td>12</td>
<td>Transplantation</td>
<td>Female</td>
<td>24</td>
<td>Glomerulonephritis</td>
</tr>
<tr>
<td>31</td>
<td>8</td>
<td>Under CAPD</td>
<td>Female</td>
<td>24</td>
<td>Alport syndrome</td>
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<td>Male</td>
<td>6</td>
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<td>7</td>
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<td>Male</td>
<td>11</td>
<td>Unknown</td>
</tr>
<tr>
<td>35</td>
<td>9</td>
<td>Change to HD</td>
<td>Female</td>
<td>5</td>
<td>Neurologic bladder</td>
</tr>
</tbody>
</table>

CAPD: continuous ambulatory peritoneal dialysis / HD: hemodialysis

Discussion

CAPD is a viable option for ESRD in children in developing countries and can be used as a bridge between ESRD and renal transplantation. It is particularly very useful where there are no pediatric hemodialysis facilities within easy reach\[^{4,11}\]. There are no pediatric data available on how to best initiate PD. Current recommendation in this regard is a waiting period of 14–21 days between catheter insertion and PD initiation\[^{12-14}\]. This period of delay in starting PD results in the need for bridging hemodialysis in patients who require immediate dialysis.

Bridging hemodialysis usually requires temporary hemodialysis catheters with vascular access problems and risk of hemodialysis catheter complications. It has been shown that hemodialysis catheters are associated with high rates of infection, thrombosis, central venous stenosis, inflammatory stress and lead to increased morbidity\[^{15,16}\].

In some developing countries, pediatric haemodialysis facilities are unavailable, and there is no maintenance hemodialysis program in most of the nephrology centers. Thus, PD remains the only available option for patients who need...
immediate dialysis and it could be a bridge between end-stage renal failure and transplantation.

So in acute situations, when the need for dialysis lasts for more than a few days, and with acute on chronic condition in end-stage renal failure, it is important that a permanent peritoneal access is implanted and PD begins immediately. Concern for early use of catheters derives mainly from the perceived risk of both dialysate leaks and the subsequent risk of peritonitis and poor survival rate of peritoneal access. It has been reported that the risk of leakage is increased in patients with little or no break-in period[17,18] and may increase the risk of other catheter-related complications like infection and catheter malfunction[6].

However, there are only a few reports about risks and benefits of immediate use of PD for prolonged time and there is no clear consensus about the starting time of PD after catheter insertion. In a recent report by Ghaffari, 18 patients who presented urgently with chronic kidney disease stage 5 were offered PD as the initial and urgent modality of dialysis. Concurrently, 9 patients with delaying use of PD catheters were included as the comparative group. In this study peritonitis, ESI, catheter-related complications, and other complications were similar between the two groups, although the number of minor leaks was higher in the urgent-start group[19]. In other study by Jo et al. the rate of pericatheter leakage and other catheter-related complications were relatively low in CAPD patients with using urgently PD catheters[20]. Pericatheter leakage, catheter tip migration, ESI, and peritonitis developed in only 1.9%, 1.9%, 3.9%, and 3.9% of patients, respectively.

Some reports indicate that the standard survival of patients on PD has been improved to 90% at first year in developed societies[21-23]. Reviewing the reports of patients on CAPD from developing countries indicate that the mortality is still high and varying between 50% in Iran, 26.6% in India and 33% in Saudi Arabia[11,24,25]. In our study the overall mortality rate was 19.6% and the most of them coexisted with multiorgan involvement (Table 3 and 4). In this study, total follow up duration was 499.5 months and 16 patients had 28 episodes of peritonitis (5% were early onset and 23% late onset), which is one episode per 17.8 months. The reported peritonitis rate by other studies vary from one episode per 19.9 patient-months to one episode per 13.2 patient-months[24,26-28]. Over the past several decades, there has been a steady decline in the rate of peritonitis in both children and adults that is largely due to improvements in connection technology and a decreased incidence of touch contamination.

Conclusion

Present study indicated that catheter-related complications were not higher than those previously reported using urgently PD catheters when PD could be initiated immediately after catheter implantation. In addition, it could be a safe bridge between end-stage renal failure and transplantation.

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Conflict of Interest: None

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