Acute Stylet Peritoneal Dialysis in Acute Kidney Injury: The Soul Never Dies

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Abstract

Background: Acute Kidney Injury (AKI) has a significant mortality rate. In developing countries, mortality due to AKI is high due to lack of access to dialysis facilities and related cost. The main goal of International Society of Nephrology (ISN) 0 by 25 initiative is to eliminate deaths due to AKI. Peritoneal dialysis is an underutilized modality in such a scenario. The aim of this study was to look into effectiveness of starting Acute stylet Peritoneal Dialysis (PD) in a resource constraint settings.

Methods: In this prospective study conducted over a year, patients with AKI due to various aetiologies were subjected to Acute stylet PD. The clinical Outcome, demographic, biochemical and treatment data was assessed. Descriptive statistics was used to analyze the data.

Results: A total of 79 (41 anuric, 33 oliguric and 5 nonoliguric) patients were included in the study. Sepsis was the predominant cause of AKI. Recovery was seen in 34% of patients. Patients with relatively preserved urine output recovered with PD in comparison to the anuric patients (p value <0.01). 58% of patients, majority of whom were anuric needed Hemodialysis (HD) in due course (7 ± 3 days) of time. The mortality in our study was 7.5%.

Conclusion: Acute stylet PD can be considered as a modality of Renal Replacement Therapy (RRT) to treat a selected (oliguric, nonoliguric) group of AKI patients and as a bridge therapy for HD in those AKI patients in anuria.

Introduction

The prevalence of Acute Kidney Injury (AKI) is increasing worldwide accounting for about 13.3 million cases per year of which 11.3 million are in low and middle income countries. Only limited data is available regarding the epidemiology of AKI from developing countries with half of the studies regarding AKI is from North America while only two studies are from Africa. AKI causes around 1.2 million deaths in developing countries and many of these deaths occur because patient progresses to a stage where Renal Replacement Therapy (RRT) is required and they don’t have access to the same. Dialysis facility is limited to major cities in many of low and middle income countries and its accessibility is further restricted by the cost factor. The International Society of Nephrology has started the “0 by 25” initiative with an aim to bring down the AKI related mortality to Zero by 2025. In India fewer than 10% patients with renal failure have access to RRT.

In our study we assessed whether acute stylet Peritoneal Dialysis (PD) can be used as emergency treatment option in patients with AKI needing RRT. Acute stylet PD which can be done at a low cost in resource limited set ups if found to be effective can be used as a bridge therapy to HD/CRRT and can prevent many deaths due to AKI.

A prospective study was conducted at SMS Medical College, Jaipur, India between March 2015 and February 2016. In this study we enrolled 79 patients with AKI due to multiple etiologies. These patients needed dialysis, but Hemodialysis was not possible at that moment due to various reasons. Hence, all the patients were started on Acute Peritoneal Dialysis using rigid PD catheter (Acute Stylet
Fig. 1: Outcome of patients initiated on APD

Table 1: Etiologies of AKI

<table>
<thead>
<tr>
<th>Cause of AKI</th>
<th>No. of patients</th>
<th>Recovered with PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sepsis</td>
<td>25</td>
<td>4</td>
</tr>
<tr>
<td>Malaria</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Post-partum</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Acute GE</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Burns</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Pancreatitis</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>CLD</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Poisoning</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>CRS</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Snake bite</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2: Age distribution of patients

<table>
<thead>
<tr>
<th>Age group</th>
<th>Total</th>
<th>Resolved after PD</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 to 19</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>20 to 29</td>
<td>14</td>
<td>4</td>
</tr>
<tr>
<td>30 to 39</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>40 to 49</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>50 to 59</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>60 to 69</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>&gt;70</td>
<td>6</td>
<td>2</td>
</tr>
</tbody>
</table>

PD). Skin of the patient was cleaned from Xiphisternum up to groins with chlorhexidine and all aseptic precautions were taken. Artificial ascitis (Priming) was created with two litres of peritoneal dialysis fluid. The rigid catheter was inserted over a trochar into the peritoneum in the midline 2cms below umbilicus. Standard 1.7% dextrose PD solution with bicarbonate (as acetate) buffer was used. Each cycle of PD lasted for 1 hour, with an inflow time of 10 minutes, dwell time of 30 minutes and an outflow time of 20 minutes. Dwell volume was 2 liters and 1 liter for patients with respiratory embarrassment. One session of PD lasted for 35±3 cycles. PD catheters were removed within a period of 48 hours. For a second session of PD (if needed) a new catheter was inserted. Peritoneal fluid sample was taken at the end of each session of PD and was sent for culture and sensitivity.

After each session of PD, the patients were reassessed clinically and by biochemical parameters and non-recovering patients were shifted to intermittent HD. The demographic, clinical, biochemical and treatment data of the cases were analyzed by standard analytical methods.

Results

A total of 79 patients were studied. The most common cause of AKI was sepsis (31.64%), followed by post partum AKI (13.92%) and Acute Gastroenteritis (11.3%). The other cause are listed in Table 1. A total of 41 patients were anuric (<100 ml/day) at presentation and 33 were oliguric (<400 ml/day) while 5 patients were having preserved urine output at presentation. Of the total 79 patients initiated on PD, 27 patients recovered with PD (defined as decreasing trend of serum creatinine, improvement in urine output) and 46 patients were converted to HD in an average of 7±2 days period. Six patients expired within 2 days of initiation of PD due to their original disease or its complications but not due to any complications related to PD (Figure 1). Age distribution of the patients recovered with PD is shown in Table 2. 67% of the patients who recovered with PD were oliguric at presentation and 22% were nonoliguric and 11% were anuric (Figure 2). 21 of 38 (55.26%) of patients with relatively preserved urine output recovered with PD while only 6 of 41 (14.63%) anuric patients recovered with PD (p value<0.01). The maximum response to PD was seen in patients with Cardio Renal Syndrome in which 4 out of 5 patients recovered with PD. This was followed by patients with acute gastroenteritis, in which 6 out of 9 patients and in post partum AKI in which 6 out of 11 patients recovered with PD. The etiology wise distribution of patients recovered with PD is given in Table 1. Total number of patients who developed peritonitis (defined by peritoneal fluid culture positivity) was 4(5.06%), while 3 patients developed bleeding from PD catheter site but none had a significant hemorrhage leading to termination of PD or blood transfusion. Three patients had outflow problem for which PD was terminated and they were shifted to HD. No other complications were noted during the procedure. Among 27 patients who recovered with PD, 16 patients required session of PD at a later date.

Discussion

The epidemiology of AKI in underdeveloped countries is different from that of developed...
world in that AKI is usually community acquired and it affects young previously healthy individuals. The most common etiologies are dehydration secondary to diarrheal disease, malaria, obstetrical causes, sepsis, nephrotoxic drugs and envenomation.\textsuperscript{2,5,6} In our study the most common etiology was sepsis followed by obstetrical causes and acute gastroenteritis. Deaths from AKI can be minimized by timely initiation of RRT. But in developing world, where access to dialysis is limited to major cities many patients succumb to death due to lack of timely dialysis.

In our study all the 79 patients were requiring dialysis due to various indications. But due to various practical problems we were not able to start the patient on HD and all of them were started on Acute PD.

Maximum response rate with Acute PD was seen in patients with Cardio renal syndrome (CRS)\textsuperscript{9,10} i.e. 4 out of 5 patients improved with PD. Various studies have already reported good results of PD in patients with CRS.\textsuperscript{9,10} Patients with acute gastroenteritis and patients with post partum AKI also showed >50% response rate. Similar results were seen in a study by Hayat et al\textsuperscript{11} which showed a 90% survival in AKI patients treated with acute stylet PD in which the predominant cause was acute gastroenteritis. None of the patients with burns and acute pancreatitis improved with PD and only 4 of 25 patients with sepsis improved with PD. The efficiency of PD in hypercatabolic states is questioned in various studies.\textsuperscript{7} But a study by Chitalia et al\textsuperscript{8} from India showed that PD can be effective in mild to moderate hypercatabolic AKI. In our study PD was found to be less effective in patients with hypercatabolic states.

Our study showed greater recovery rates among elderly patients with AKI than younger patients with AKI (12/25 patients >50 years and 15/54 years <50 years) with PD. PD is essentially a form of CRRT that correct the volume and metabolic status in a gentle way without producing hemodynamic instability. In patients who are more vulnerable to hemodynamic instability like elderly patients, Peritoneal Dialysis may give better results as compared to hemodialysis.\textsuperscript{10,12}

Probably the most important finding in our study is the relatively better recovery rates among patients with preserved urine output. In other words 21 of 38(55.26%) of patients with urine output >100 ml recovered with PD while only 6 of 41(14.63%) anuric patients recovered with PD (p value<0.01). The outcome of AKI patients with anuria is found to be inferior to patients with preserved urine output.\textsuperscript{13,14} In spite of extensive searches we were not able to find any study comparing efficacy of PD in anuric and non anuric AKI. So we couldn't conclude whether the increased responsiveness shown by non anuric AKI patient in our study is significant or is it just an extension of the better outcome of AKI patients with preserved urine output.

Flexible peritoneal dialysis catheter is preferred over rigid catheters for peritoneal access in acute PD, also as they are associated with lower rates of peritonitis and allows higher dialysate flow rates, but is expensive and needs expertise for insertion.\textsuperscript{15-18} Rigid catheters carries a higher risk of peritonitis, poor dialysate flow rate, catheter dysfunction and bowel perforation.\textsuperscript{19,20} In our study none of the patient had major complications in the form of bowel or bladder perforation, or hemorrhage requiring transfusion. Five patients had catheter dysfunction and three of them had outflow failure requiring termination of PD and in the remaining two patients we were able to continue PD after catheter repositioning. Eventhough older studies showed a higher rate of peritonitis, recent studies using even rigid catheters showed rate of peritonitis between 2.8% to 4%,\textsuperscript{8,16,21,22} In our study the rate of peritonitis was 5.06%.

Numerous studies have assessed the role of acute PD in AKI\textsuperscript{23} including few studies using rigid catheter for peritoneal access\textsuperscript{8,16,21,22} and there has been a resurgence in the interest of the use of PD in AKI.\textsuperscript{24,25} Three prospective Randomized Controlled Trials (RCTs) compared PD with extracorporeal blood purification therapies of which two were using rigid catheters. Study by Phu et al from Vietnam concluded that Continuous Renal Replacement Therapy (CRRT) is clearly superior to PD in terms of mortality, while one study from India\textsuperscript{22} and one study from Brazil\textsuperscript{26} showed similar mortality rates. Aim of our study was not to compare between PD and other extracorporeal blood purification therapies. Rather our study is an attempt to confirm the efficacy of acute stylet PD as a rescue therapy in AKI in resource constraint settings. In our study 34% patients recovered with PD and the total mortality rate was 13.9% which could have been much higher if there was a delay in the initiation of dialysis.

Acute stylet PD can be done in the remotest locations, is less expensive, technically less demanding and requires minimum infrastructure than hemodialysis. Of note, acute stylet PD in Hyderabad, India can save a life with less than 150 US dollars (Nayak KS), the cost for a 72 hours PD session.\textsuperscript{29} In our centre we were able to provide at a cost less than half of this amount. We postulate that acute Stylet PD may be The Aspirin of RRT in AKI.

Limitations of the Study

The delivered dose of PD was not calculated in our study. Till now there are no consensus regarding dosage of dialysis in AKI.\textsuperscript{30} Although evidence to support this target is limited, one of the most widely accepted
recommendation is to target a weekly Kt/V urea of 2.1. A Kt/V in this range can be easily achieved with standard volume PD. And most importantly the dose not necessarily means the efficacy of PD in AKI and other clinical and biochemical parameters should also be considered in patient with AKI.

**Conclusion**

Acute PD can be considered a viable modality option in the treatment of AKI especially in resource constraint/emergent settings as there is no firm evidence to indicate inferiority of PD for management of AKI. The feasibility and success of PD for AKI depends on appropriate patient selection, proper PD technique, and center experience. We suggest that PD can be considered as a modality of RRT to treat a selected (oliguric, nonoliguric) group of AKI patients. Further it may act as a bridge therapy in AKI patients with anuria in probably reducing the mortality in AKI. It is a simple, inexpensive and efficient modality of RRT that may help in achieving one of the goals of The ISN “0 by 25” initiative.

**References**