Intermittent Peritoneal Dialysis in Acute Kidney Injury

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Objective: *The mortality rate of acute kidney injury (AKI) patients is high despite of new advanced continuous renal replacement therapy (CRRT), which has widely become the treatment of choice in patients who are hemodynamically unstable. Nevertheless, the effectiveness of CRRT in improving the survival outcome is still unclear. Therefore, many centers still use intermittent peritoneal dialysis (IPD) or intermittent hemodialysis (IHD) in hospital where CRRT is unavailable. The present study was carried out to evaluate outcome of AKI patients who were treated with IHD and IPD in Saraburi Hospital.*
Material and Method: *A retrospective study of AKI patients requiring dialysis during 2004 to 2009 was conducted. Patients who were under 15 years old or underwent more than one modality of dialysis were excluded. Demographic data and mode of RRT were analyzed for survival.*
Results: *Of all 145 patients, 101 were admitted into ICU. Mean age of patients was 61.6 $\pm$ 17.8 years and 60.7% of all patients were male. Acute tubular necrosis was the most common cause of AKI, whereas volume overload was the leading indication for RRT. Overall mortality was 68.3%. There was no statistically significant difference in mortality rate between the two modes of dialysis.*
Conclusion: *The mortality rate of AKI patients is high despite having dialysis support. There is no statistically significant difference in mortality rate between IHD and IPD among these patients.*

Keywords: *Acute kidney injury, Intermittent peritoneal dialysis, Outcome*

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Acute kidney injury (AKI) is a common problem found in hospital patients. The incidence of AKI in hospitalized patients is 0.15 to 7.2%, and is even higher (5 to 20%) among ICU patients[1]. Nowadays, the incidence of AKI tends to rise continuously due to many etiologies such as high risk investigations[2,3], administration of nephrotoxic drugs[4], and co-morbid diseases. Management for these patients is not only supportive treatment but also a renal replacement therapy (RRT) which has played an important role in indicated patients. The use of continuous renal replacement therapy (CRRT) has soared recently and becomes the treatment of choice in AKI patients who are hemodynamically unstable with multiple organ failure. CRRT has been expected to improve the survival outcome[6,7], although the therapy is costly and labor load. Many studies[8-12] fail to demonstrate the superiority of CRRT over intermittent hemodialysis (IHD) in decreasing the mortality rate, which is still high (> 40%) and can exceed 70% in the presence of severe infection or sepsis[13]. Intermittent peritoneal dialysis (IPD) remains a preferred therapeutic mode in many countries and some remote areas[14,15] since there is no vascular access involvement, is apparently less expensive, and does not require highly trained personnel or complex equipments. IPD has been proved to be as effective as IHD in treating AKI patients with unstable vital signs and volume and electrolyte imbalances[5]. However, the use of IPD has declined in recent years[16]. The possible explanations could be due to insufficient exposure to PD technique during nephrology training and seemingly more technologically advanced mode in hemodialysis. The present study analyzed the outcome of RRT patients (IPD vs. IHD) in Saraburi Hospital, where both

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treatments has been conducted in AKI patients for a long period of time.

Material and Method

The population of the present study consisted of AKI patients aged 15 years or more and were hospitalized in Saraburi Hospital (a tertiary care hospital), Saraburi province, Thailand, during January 2005 to December 2009. Patient information was collected from the data center of the hospital. The main inclusion criterion was AKI patients who underwent either IPD or IHD. Patients who were treated with more than one modality of dialysis were excluded from the study. The patients were classified into two groups according to the mode of dialysis (IPD or IHD). The primary end point was the hospital mortality rate. Other factors, including the need for respiratory support, co-morbid diseases, and the need for ICU care, were evaluated with the survival outcome.

Statistical analysis

Results were presented as medians or mean $\pm$ standard deviation, according to the characteristics of each variable, with a 5% ($p < 0.05$) significant level. For parametric variables, the independent t-test, was used to compare parametric variables between the two groups. ANOVA followed by the Newman-Keuls test were used for multiple comparisons between groups. For non-parametric variables, comparisons were conducted by using the Wilcoxon test and the Kruskal-Wallis test.

Results

Among 167,477 patients admitted into Saraburi Hospital from the year 2004 to 2009, there were a total of 157 AKI patients (0.094%) who required dialysis treatment. Out of 157 patients, 145 were included in the present study, which consisted of 62 patients in IPD group and 83 patients in IHD group. The 12 patients were excluded because multiple modes of dialysis treatments were performed. Mean age of the patients were 63.2 $\pm$ 15.7 years in the IPD group and 60.4 $\pm$ 19.2 years in the IHD group. Patient characteristics were similar in both groups, including age, gender, ICU admission, the need for respiratory support, underlying diseases, sepsis condition, and initial blood chemistries (Table 1). However, the APACHE II score in IPD group was significantly higher than IHD ($p = 0.01$) (Table 2). ATN was the most common cause of AKI (118 patients, 81.4%) (Fig. 1).

The most common indication for dialysis treatment was volume overload (70 patients, 48.3%), followed by uremia (40 patients, 27.6%), anuria (21 patients, 14.5%), and severe acidosis (9 patients, 6.2%) (Fig. 2).

Complications during dialysis treatments occurred in IHD group more often than IPD group (31.3% vs. 11.3%, $p < 0.05$) (Table 2). In IPD group, the incidence of catheter-related infection was 3.2%, but there were no arrhythmia, hypertension or chest pain occurred.

Mode of dialysis, ICU admission, and underlying diseases did not have any effects on survival outcomes. However, the mortality rates were significantly higher in patients who required ventilator and patients who had sepsis ($p < 0.001$ and $p = 0.003$, accordingly) (Table 3).

The average APACHE II score of survived patients was lower than dead patients (19.7 $\pm$ 5.3 vs. 24.7 $\pm$ 5.4, $p < 0.001$). Mean age, levels of serum albumin, BUN, serum creatinine, and hematocrit (Hct) were similar in both outcomes (Table 3). Patients who required ventilator or were in sepsis condition appeared to have higher mortality rate (OR = 10.9, 95% CI = 4.45-26.75 and OR = 3.94, 95% CI = 1.54-10.07) (Fig. 3).

Discussion

The incidence of AKI in the present study was 0.094% which may be underestimated. Since AKI

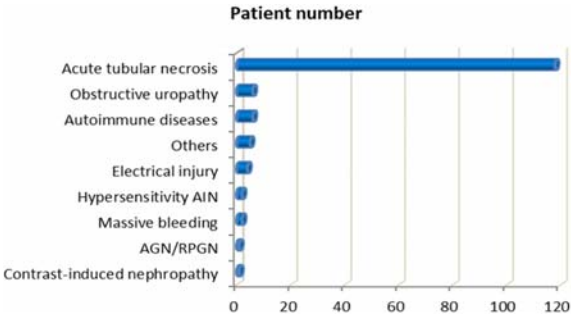

Fig. 1 Etiologies of acute kidney injury

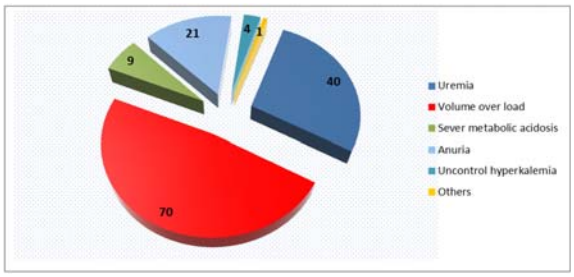

Fig. 2 Indication for dialysis treatment

Table 1. Clinical characteristic and demographic in each dialysis modes

Patient characteristics	Modes		p-value
	IPD (62)	IHD (83)	
Male Gender (%)	36 (58.1)	52 (62.7)	0.576
Mean age (yr)	63.18 ± 15.71	60.42 ± 19.17	0.357
Underlying diseases (%)			
Diabetes mellitus	21 (33.9)	20 (24.1)	0.196
Hypertension	26 (41.9)	40 (48.2)	0.454
Ischemic heart disease	10 (16.1)	11 (13.3)	0.626
Malignancy	5 (8.1)	10 (12.0)	0.436
ICU admission (%)	43 (69.4)	58 (69.9)	0.946
Ventilator consumption (%)	51 (82.3)	61 (73.5)	0.213
Sepsis (%)	56 (90.3)	67 (80.7)	0.111
APACHE II score	24.91 ± 5.88	21.72 ± 5.39	0.001*
BUN (mg/dL)	87.27 ± 51.66	100.46 ± 47.68	0.114
Serum creatinine (mg/dL)	6.55 ± 3.32	8.20 ± 10.47	0.234
Serum albumin (g/dL)	2.63 ± 0.68	2.80 ± 0.71	0.196

Table 2. Complications of intermittent peritoneal dialysis compared to intermittent hemodialysis

Complications	IPD (62)	IHD (83)
None	88.7*	68.7
Arrthymia	0.0	1.2
Hypotension	8.1	27.7
Hypertension	0.0	1.2
Chest pain	0.0	1.2
Infection	3.2	0.0

*p = 0.05

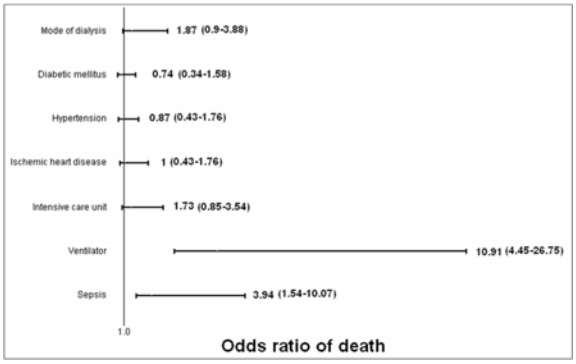

Fig. 3 Odds ratio (95% confidence interval) of patient death

patients who were dead before dialysis or not accepted for dialysis were not documented in the present study.

Old age was predominant which is in accord with a previous study by Hussain et al[17]. There was no statistical difference between two groups in terms of mortality rate, which was the main objective of the present study. This finding was similar to an earlier study[18]. However, the survival rate in IHD group was seemingly higher than IPD group. This finding may be due to bias selection, since IPD group had higher APACHE II score than IHD group. Although CRRT has become widely accepted as the treatment of choice for AKI patients, many physicians still prefer PD technique due to its simplicity in nature, high availability, together with low risk of bleeding, hypotension, and electrolyte disequilibrium. IPD has been used with success in many countries for the treatment of AKI, especially those in hospitals where more technologically advanced dialysis techniques are not available.

IPD also has many limitations, such as the need for intact peritoneal cavity, risk of peritoneal infection, mechanical complications, and occurrence of protein losses[19]. Rao et al[20] suggested the reason for declining usage of IPD may be related to the perception that IPD is labor intensive, fear of a malfunctioning catheter, insufficient exposure to IPD during nephrology training, and comfort in using hemodialysis. Although there were many randomized control trial studies comparing outcomes among different modes of dialysis, the results were varied and inconclusive. Phu et al[21] compared continuous veno-venous hemo-filtration (CVVH) with IPD for the efficacy, safety, practicality, and cost of short-term

Table 3. Factors related to the outcome (survival)

Factors	Outcomes		p-value
	Dead n = 99 (68.2%)	Alive n = 46 (31.8%)	
Age (years)	62.6 ± 17.2	59.4 ± 19.0	0.304
Mode of dialysis (%)			0.241
IPD	47 (47.5)	15 (32.6)	
IHD	52 (52.5)	31 (67.4)	
Underlying diseases (%)			
Diabetes mellitus	26 (26.3)	15 (32.6)	0.430
Hypertension	44 (44.4)	22 (47.8)	0.704
Ischemic heart disease	15 (15.2)	6 (13.0)	0.737
ICU admission (%)	73 (73.7)	28 (60.9)	0.117
Ventilator (%)	90 (90.9)	22 (47.8)	0.000*
Sepsis (%)	90 (90.9)	33 (71.1)	0.003*
APACHE II score	24.7 ± 5.4	19.7 ± 5.3	< 0.001*
Initial blood chemistries			
BUN (mg/dL)	92.9 ± 51.5	99.0 ± 45.7	0.496
Serum creatinine (mg/dL)	7.0 ± 9.5	8.6 ± 4.5	0.262
Hematocrit (%)	30.9 ± 7.5	28.5 ± 6.5	0.067
Serum albumin (g/dL)	2.7 ± 0.7	2.9 ± 0.7	0.074

* $p < 0.05$

dialysis. The authors concluded that hemofiltration was superior to PD in the treatment of infection-associated AKI. In contrast, Gabriel et al[22] compared continuous PD with hemodialysis in treating AKI patients and found no difference in mortality outcome. With more emphasis on education about PD in treating AKI during nephrology training, more clinical trials, and an appropriate patient selection for PD usage, PD will become the foremost treatment option for AKI again in the future.

Potential conflicts of interest

None.

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การล้างไตผ่านทางหน้าท้องในภาวะไตบาดเจ็บฉับพลัน

ณรงค์ศักดิ์ วัชโรทน, วิวัฒน์ สยุมภูรุจินันท์, อุดมศักดิ์ อุดมผล, ณภัทร หลีอาภรณ์, เถลิงศักดิ์ กาญจนบุษย์

วัตถุประสงค์*: พบว่าอัตราการเสียชีวิตในผู้ป่วยภาวะไตบาดเจ็บฉับพลันยังสูงแม้จะมีวิธีการล้างไตทางหลอดเลือดแบบทันสมัยด้วยข้อจำกัดเรื่องค่าใช้จ่ายและประสบการณ์ของบุคลากรทำให้โรงพยาบาลหลายแห่งในประเทศยังต้องเลือกใช้การล้างไตทางหน้าท้องและทางหลอดเลือดแบบมาตรฐาน การศึกษานี้ทำในโรงพยาบาลสระบุรีเพื่อเทียบการล้างไตแบบมาตรฐานทั้งสองวิธี*

วัสดุและวิธีการ*: ทำการศึกษาแบบย้อนหลังในช่วง พ.ศ. 2547 ถึง พ.ศ. 2552 ในผู้ป่วยภาวะไตบาดเจ็บฉับพลันที่ต้องรับการรักษาโดยการล้างไต*

ผลการศึกษา*: มีผู้ป่วย 145 ราย เข้าร่วมการศึกษาอายุเฉลี่ย 61.6 ปี เป็นผู้ชายร้อยละ 60.7 ข้อบ่งชี้ในการทำการล้างไตที่พบมากที่สุดคือ ภาวะน้ำเกิน มีอัตราการเสียชีวิตร้อยละ 68.3 ไม่พบความแตกต่างในการเสียชีวิตในการรักษาโดยการล้างไตแบบมาตรฐานทั้ง 2 วิธี*

สรุป*: พบอัตราการเสียชีวิตสูงในภาวะไตบาดเจ็บฉับพลัน แม้ได้รับการรักษาโดยการล้างไต ไม่มีความแตกต่างในการเสียชีวิตในการรักษาโดยการล้างไตทางหน้าท้องเมื่อเทียบกับการล้างไตทางหลอดเลือดแบบมาตรฐาน*