Special Article

Efficacy and Hemodynamic Outcome of Prolonged Intermittent Renal Replacement Therapy (PIRRT) in Critically Ill Patients: A Preliminary Report

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Background: *Acute kidney injury (AKI) is frequently part of a multiple-organ dysfunction syndrome presenting in critically ill patients. Prolonged intermittent renal replacement therapy (PIRRT) provides the advantages of both continuous renal replacement therapy (CRRT) in term of hemodynamic stability and the cost-effectiveness of intermittent hemodialysis (IHD). This study aims to study PIRRT in the aspects of efficacy and hemodynamic outcomes.*

Material and Method: *The authors present a single-center experience accumulated over 20 months from February 2009 to September 2010 with two PIRRT techniques, called SLEDD and SLEDD-f. Eight-hour treatments were performed daily for three consecutive days. Hemodynamic parameters were recorded at different time points and blood samples were taken for urea and solute clearance before and after treatment.*

Results: *Sixty critically ill patients with AKI were randomly assigned to undergo PIRRT, 33 patients received SLEDD and 27 patients received SLEDD-f. Our results demonstrate significant decrease in BUN, creatinine, serum potassium and phosphate in both PIRRT techniques. Moreover, with the use of similar filters and blood flow rates, SLEDD-f was comparable with SLEDD in terms of small solute clearance and detoxification. For hemodynamic outcomes, the authors found that MAP increased after completion of the first session of PIRRT and along the three consecutive days of daily PIRRT, together with the gradual improvement of vasopressor scores.*

Conclusion: *The prolonged intermittent renal replacement therapy (PIRRT) appears to be an outstanding technique for treatment of critically ill patients with AKI and it also seems to have cost effectiveness. Moreover it is suitable to a limited resource region such as Thailand.*

Keywords: *Acute kidney injury (AKI), Prolonged intermittent renal replacement therapy (PIRRT), Sustained low-efficiency daily dialysis (SLEDD), Sustained low-efficiency daily diafiltration (SLEDD-f), Critically ill patient*

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Acute kidney injury (AKI) frequently is part of a multiple-organ dysfunction syndrome presented in critically ill patients, and such patients have a high mortality rate despite advance in extracorporeal renal replacement therapy (RRT)[1]. For decades, continuous renal replacement therapies (CRRTs) such as continuous venovenous hemofiltration (CVVH) were thought to offer better cardiovascular stability, resulting in better survival, in critically ill patients than conventional intermittent hemodialysis (IHD)[2]. Both conventional IHD and CRRTs have certain advantages, but also several disadvantages. While IHD remains the domain of nephrologists, CRRTs have been performed in the intensive care units (ICUs), mostly with the involvement of ICU nurses.

In the ICU, an important goal for treating patients with AKI is to provide the optimal RRT for the patient in a way that is cost-effective and easy to handle. This goal has led to the "hybrid" therapy to treat AKI- *i.e.*, prolonged intermittent renal replacement therapy (PIRRT) which combines advantages of both intermittent and continuous RRTs[3,4]. This "hybrid" RRT utilizes equipment formerly designed for conventional IHD and therefore does not require expensive industrially produced extracorporeal circuit and substitution fluid. Alternative terms of PIRRT are

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sustained low-efficiency daily dialysis (SLEDD)[5,6] and sustained low-efficiency daily diafiltration (SLEDD-*f*)[7]. SLEDD is performed using diffusive solute clearance as used in IHD but over a prolonged period (usually 8-12 hours with SLEDD vs. 3-4 hrs with IHD). SLEDD-*f* using mixed diffusive and convective solute clearance is performed for 8-12h of hemodiafltration. Theoretically, convective clearance has a better advantage than diffusion in terms of removing higher molecular weight substances, which include many inflammatory mediators in sepsis. This concept leads to use of SLEDD-*f* instead of SLEDD in some ICUs[7].

PIRRT is an increasingly popular RRT in critically ill patients with AKI in the ICU. An important aspect of PIRRT is its ease of use for the ICU and dialysis staffs and its high degree of flexibility. This hybrid technique requires less work in night shifts and allows for patient mobility and out-of-unit diagnostic and therapeutic procedures. It provides comparable clearances to CRRT with good clinical tolerance at less cost and is less labor-intensive[8].

The authors have since 2009 developed operational protocols and a demarcation of roles between ICU and dialysis nursing personnel for performing PIRRT in our ICU. The present study aimed to prove that the prolonged intermittent renal replacement therapy (PIRRT), both SLEDD and SLEDD-*f* techniques, is an effective and feasible treatment for critically ill patients, and improves metabolic derangement without induction of hemodynamic instability. The authors also compared clinical outcomes between patients undergoing SLEDD and SLEDD-*f*.

Material and Method

The present study was prospectively performed at the medical intensive care unit (ICU) of a tertiary care referral center (Siriraj Hospital, Bangkok, Thailand), with the approval of the clinical research ethics committee of the same institution. All the patients were admitted to the medical ICU of our hospital between February 2009 and September 2010.

A total of 60 patients who had developed AKI that required RRT in the ICU were eligible for inclusion in the present study. The main criteria for inclusion was a clinical diagnosis of AKI[9] and that the patient fulfilled at least one of following conditions: (i) volume overload despite diuretic administration, (ii) oliguria or anuria in spite of fluid resuscitation and diuretic administration, (iii) azotemia (blood urea nitrogen > 70 mg/dL), (iv) hyperkalemia (serum K > 6.5 mmol/L) that was refractory to medical treatment and (v) severe metabolic acidosis despite medical treatment. The exclusion criteria were patient's age of more than 80 year or less than 15 year old and the presence of chronic kidney disease stage V (estimated glomerular filtration rate < 15 ml/min/1.73 m^2). Acute Physiology and Chronic Health Evaluation (APACHE) II scores were calculated from physiological parameters obtained during first 24 hours of ICU admission.

PIRRT techniques

From February 2009 and September 2010, sixty patients were enrolled in the present study and were randomly allocated by computerized randomization (www.randomization.com) to received treatment either SLEDD or SLEDD-*f* in a prospective manner. All patients or next of kin gave written informed consent. All SLEDD and SLEDD-*f* prescriptions were provided by the attending nephrologists according to the clinical needs of the patients. The treatment was given daily for three consecutive days, then three to five sessions per week according to clinical need. Both treatments were performed using the hemodialysis machine which can provide the prescribed dialysis treatment. A standard 1.8 m^2 polysulfone high flux dialyzer (HF80S; Fresenius, Kuf 55 ml/h x mmHg) was used for both SLEDD and SLEDD-*f*. Blood flows (Qb) were set to 250 ml/min in both groups. All vascular accesses used for dialysis treatments were 11.5 Fr (24 cm) catheters placed at femoral vein. Default treatment duration was 8 hours. SLEDD or SLEDD-*f* treatments that were discontinued before completion for any reason were restarted until completion of 8 hours.

For the SLEDD treatment, the ultrapure dialysis fluid was prepared by stepwise ultrafiltration of water and bicarbonate-containing dialysis fluid using polysulfone ultrafilter (Diasafe® plus). Countercurrent dialysate flows (Qd) for SLEDD were routinely set to 300 ml/min. For SLEDD-*f* treatment, sterile-pyrogen free replacement solution was prepared from on-line hemodiafiltration system of Fresenius 5008 machine. Dialysis purity was guaranteed by regular endotoxin and microbiological testing. Qd of SLEDD-*f* was usually set to 200 ml/min and online-hemodialfiltration (Qf) to 100 ml/min in pre-dilution mode. Standard dialysate in both groups was used with default concentrations as following: Na 138 mmol/L, K 3 mmol/L, Cl 108 mmol/L, HCO_3 28-32 mmol/L, Ca 1.75 mmol/L and Mg 0.5 mmol/L.

Unfractionated heparin infusion into the

extracorporeal system was used, unless contraindicated, to achieve a target of aPTT ratio 1.5 times above upper normal limit. For patients that contraindicated to anticoagulant such as those with active bleeding or recent surgery, the authors performed dialysis treatment without any anticoagulation.

All SLEDD and SLEDD-*f* treatments were started and discontinued by a dialysis-specialized nurse and monitored over treatment duration by ICU nurses. Hemodialysis personnel with SLEDD experience were available for technical advice.

Hemodynamic measurement

The authors recorded the blood pressures at 4 time points during the first day of initiation of PIRRT (at starting, 4 hr, 8 hr, 12 hr) and 2 time points for the next 2 consecutive days (at initiation of PIRRT of 2nd and 3rd sessions). Mean arterial pressure (MAP) was calculated by addition of diastolic blood pressure to one-half of pulse pressure (the difference between systolic blood pressure and diastolic blood pressure). Hemodynamic instability during a given session was defined as the composite of a > 20% reduction in mean arterial pressure or any escalation in vasopressor requirements[10]. Hypotension was defined as a systolic blood pressure less than 90 mmHg at any time point during treatment. The dose of inotropic/vasopressor agents is expressed as the inotropic equivalent score (IE score)[11,12], a variable calculated as: (Dopamine dose x 1) + (Dobutamine dose x 1) + (Adrenaline dose x 100) + (Norepinephrine dose x 100) + (Phenylephrine dose x 100), where in all doses are expressed as μg/kg/min.

Metabolic measurement

Blood samples were collected immediately before treatment initiation and immediately upon treatment discontinuation of the first session of PIRRT, in order to measure blood urea nitrogen (BUN), serum creatinine, potassium and phosphate.

Statistical analysis

All normally distributed results were given as means ± standard deviation (SD) or percent. Non-normally distributed values are reported as median (minimum, maximum). Statistical analyses were performed with PASW Statistics version 18.0 (IBM corporation, Somers, NY). Continuous variables were analyzed with the Student's t-test or Mann-Whitney U-test method depending on distribution of data. Categorical variables were analyzed with Chi-square test. Differences of serial measurement of normally-distributed variables were analyzed using analysis of variance for repeated measurements with Bonferroni's correction. For nonnormally-distributed variables, Friedman's two-way analysis of varience with post-hoc Wilcoxon signed rank test was used to identify whether changes had occurred over time. A p-value of < 0.05 was considered statistically significant.

Results

Sixty patients were randomly assigned to undergo both intermittent renal replacement therapies (PIRRT); 33 patients received SLEDD and 27 patients received SLEDD-*f*. The demographic details along with PIRRT types are shown in Table 1. The patients undergoing SLEDD and SLEDD-*f* did not show significant differences in age, sex, BMI and baseline serum creatinine. The individual severity of illness was calculated using APACHE II scoring system. Mean APACHE II score at ICU admission were 26.58 ± 7.4 and 26.93 ± 7.07 in SLEDD and SLEDD-*f* group, respectively ($p = 0.85$). The 28 d mortality was 46.7% among all cohorts; 54.5% in SLEDD group and 37% in patients receiving SLEDD-*f* ($p = 0.22$).

Comparison of pre-and post- treatment with SLEDD and SLEDD-*f* of small solute levels are listed in Table 2. Significant decreases in BUN and serum creatinine in these critical patients were similar among SLEDD and SLEDD-*f*, as were other small solute clearance; thus, in the present study, the authors measure serum potassium and phosphate concentration.

Table 3 demonstrates median MAP during both modalities of PIRRT. MAP was 81 mmHg at pretreatment, 85 mmHg at midtreatment and 89 mmHg at the end of treatment in patients treated with SLEDD. MAP in patients undergoing SLEDD-*f* at similar time points were 82 mmHg, 92 mmHg and 88 mmHg, respectively. When MAPs were compared between the two treatment modalities, they did not differ significantly. The authors then reported hemodynamic changes of all populations studied in Table 4.

Patient's MAP pre-PIRRT was 84 ± 17 mmHg, mid-PIRRT was 92 ± 17 mmHg and end-PIRRT was 92 ± 17 mmHg. Although a significant amount of ultrafiltrae (around 1,000 ml per session) was removed during PIRRT treatment, MAP increased significantly over time during 1st session of PIRRT ($p < 0.001$) and during first 3 consecutive day of PIRRT ($p = 0.035$) (Table 4, Fig. 1). MAP of patients was maintained at the target values according to instructions whereas the vasopresor/

Table 1. Individual patient characteristics according to PIRRT type

Variables	SLEDD (n = 33)	SLEDD-*f* (n = 27)	Total (n = 60)
Age (year)	57.04 ± 21.48	57.67 ± 18.2	57.32 ± 19.91
Sex: male	20 (60.6%)	16 (59.3%)	36 (60%)
BMI (kg/m2)	23.7 ± 4.21	24.45 ± 5.57	24.04 ± 4.84
Baseline creatinine (mg/dl)	1.19 ± 0.58	1.25 ± 0.57	1.21 ± 0.57
APACHE II	26.58 ± 7.4	26.93 ± 7.07	26.74 ± 7.2
Sepsis, n (% of patients)	27 (81.8)	22 (81.5%)	49 (81.7%)
Use of ventilator, n (% of patients)	31 (94.0%)	25 (92.6%)	56 (93.3%)
Pre-dialysis MAP (mmHg)	85.25 ± 20.24	82.26 ± 12.4	83.9 ± 17.1
IE dose Pre-dialysis	6.6 (0, 38.3)	11.0 (0, 53.2)	9.6 (0, 53.2)
Use of inotrope/vasopressor	20 (60.9%)	20 (74.1%)	40 (66.7%)
28-day mortality	18 (54.5%)	10 (37.0%)	28 (46.7%)

PIRRT: prolonged intermittent renal replacement therapy; SLEDD: slow low efficiency daily dialysis; SLEDD-*f*: slow low efficiency daily diafiltration; BMI: body mass index; APACHE II: Acute Physiology and Chronic Health Evaluation score II; MAP: mean arterial pressure; IE: inotropic equivalent score

Table 2. BUN, serum Creatinine, Potassium, and Phosphate Concentrations before and after the 1st session of PIRRT

	Pre-RRT	Post-RRT	p-value
BUN (mg/dl)			
SLEDD	91.3 ± 34.7	20.7 ± 13.4	< 0.001
SLEDD-*f*	90.5 ± 36.2	22.1 ± 11.5	< 0.001
Serum creatinine (mg/dl)			
SLEDD	5.3 ± 3.5	1.5 ± 1.0	< 0.001
SLEDD-*f*	4.8 ± 2.4	1.5 ± 1.0	< 0.001
Serum potassium (mmol/L)			
SLEDD	4.6 ± 1.2	3.6 ± 0.5	< 0.001
SLEDD-*f*	4.4 ± 0.9	3.7 ± 0.6	< 0.001
Serum phosphate (mg/dl)			
SLEDD	7.9 ± 5.0	3.0 ± 1.4	< 0.001
SLEDD-*f*	6.7 ± 3.2	3.3 ± 1.5	< 0.001

Table 3. Median MAP just before initiation, midway, and termination of 1st session of PIRRT

Blood pressure (mmHg)	SLEDD	SLEDD-*f*	p-value
Pre-MAP	81 (53, 130)	82 (57, 101)	0.96
Mid-MAP	85 (64, 131)	92 (62, 138)	0.55
End-MAP	89 (63-136)	88 (70-108)	0.79

MAP values are reported as median (min, max)

inotrope doses as represented by the IE dose gradually decreased over a similar time frame.

Discussion

Acute kidney injury is the common condition found in intensive care units (ICUs). These critically ill patients usually have multiple organ dysfunction and need ventilatory support and vasopressor agents. Therefore the choice of RRT modality should be chosen based on not only the treatment efficacy but also cardiovascular tolerability. PIRRT provides benefit to these critical ill patients by combining the advantages

Table 4. Effects of Prolonged intermittent renal replacement therapy (PIRRT) on hemodynamic variables

Duration	Pre-PIRRT	Mid-PIRRT	End-PIRRT	12-h post starting Rx	Day 2	Day 3	p-value[1]	p-value[2]
SBP	118.0 ± 23.4	127.6 ± 22.7	127.4 ± 21.8	123.8 ± 23.1	123.7 ± 22.3	127.8 ± 22.7	0.003	0.068
MAP	83.9 ± 17.0	92.3 ± 17.9*	92.0 ± 16.6*	88.8 ± 17.6	88.1 ± 17.7	90.5 ± 18.1	< 0.001	0.035
IE dose	9.6 (0. 53.2)	8.1 (0, 48.7)	6.9 (0, 44.7)	7.1 (0, 44.6)	4.3 (0, 78.3)	2.9 (0, 92.9)	0.190	< 0.001
Uf, ml		850 (0-4,000)			1,000 (0-4,500)	1,500 (0-4,500)		

Normally-distributed values are reported as mean □ standard deviations, and nonnormally-distributed values are reported as median (min, max). Differences of serial measurement of normally-distributed variables were analyzed using analysis of variance for repeated measurements with Bonferroni's correction. Differences of serial measurement of nonnormally-distributed variables were analyzed using Friedman's two-way analysis of varience with post-hoc Wilcoxon signed rank test.
p-value[1]: statistical difference during 1st session of PIRRT, p-value[2]: statistical difference during first 3 days of PIRRT. *p < 0.05 compared with baseline

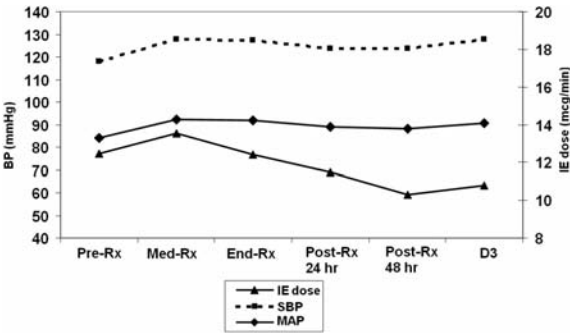

Fig. 1 Hemodynamic variables during pre-PIRRT, mid-PIRRT, End-PIRRT and 12-h, Day 2, Day 3 post starting treatment

of IHD and CRRT together. This dialysis method was easy to handle, had low cost and was able to eliminate uremic toxin; at the same time, it achieved gentle volume removal[4]. Furthermore, on a daily basis, the patient obtains leisure time from RRT, which allows for other brief treatments and therapeutic procedures.

The present study aims to identify the treatment efficacy and cardiovascular tolerability between the two modes of PIRRT; SLEDD (convection) and SLEDD-*f* (mixed convection and diffusion) in a randomized controlled study.

Similar to previous reports[5-7], the authors have found excellent efficiency of the prolonged intermittent renal replacement therapy (PIRRT) for the clearance of urea, creatinine and small solutes such as potassium and phosphate. Our results demonstrate that with the use of similar filter and blood flow rate, SLEDD-*f* was comparable with SLEDD in term of small solute clearance (Table 2). Kielstein et al[13] had previously studied the efficacy of CVVH and extended dialysis on small solute removal and found that both modalities had no significant difference. The authors findings were parallel with previous studies in that both prolonged intermittent therapies significantly demonstrated effective detoxification independent of the mechanism of solute removal.

Because all patients had hemodynamic instability and most were diagnosed as sepsis/septic shock and administrated vasopressor/inotrope, the authors frequently monitored not only hemodynamic variables but also the IE dose and ultrafiltrate volume removed during PIRRT at set time intervals. Comparison of SLEDD and SLEDD-*f* did not find significant difference in hemodynamics before, during and after each session of treatment. As was demonstrated, stabilization of MAP was achieved. At the same time the authors could taper dosage of inotropic/vasopressor agents, even substantial ultrafiltrate volume removed during first 3 consecutive days of PIRRT. Many previous studies had reported cardiovascular tolerability in patients who underwent PIRRT[8,10,14]. Marshall et al found that SLEDD and SLEDD-*f* were hemodynamically tolerated in most patients and achievement of ultrafiltration goals was possible in most cases[6,7].

Kumar et al in another previous study examined the hemodynamic variable of CVVH and extended dialysis[15]. They concluded that extended dialysis is a safe, effective alternative to CRRT in the viewpoint of hemodynamic stability. The authors findings were parallel to these studies in that the authors also did not find significant hemodynamic instability.

In contrast, the authors found that MAP increased after completion of the first session of PIRRT and along the 3 consecutive day of daily PIRRT. In addition, vassopressor score also improved gradually as presented by decrease of IE scores over time. Moreover, we achieved adequate ultrafiltration volume in each session of treatment.

Therefore, our results were parallel to previous studies in that it was found that PIRRT, both SLEDD and SLEDD-*f*, does not interfere with hemodynamic outcome when compared with CRRT.

Concerning 28-day mortality predicted by APACHE II score, the authors found that predicted mortality was 59.6%. But in the present study, the observed 28 d-mortality was lower (46.7%) than predicted by APACHE II. This could be due to factors that might be related to advances in critical care technology, continuous presence of intensivists at bedside, modern intensive therapy such as early goal directed therapy for septic shock, or high-quality teamwork for the PIRRT procedure.

The present study has a number of limitations. Firstly, our population was composed mainly of patients admitted due to severe medical illnesses. Most had septic shock accompanied by multiple underlying comorbidities, and the average age was quite high. For these reasons, the outcome of treatment with regards to hemodynamics and mortality may be worse than patients in other age groups or patients without comorbid diseases, such as those in the surgical or anesthetic ICU. Conversely, since the present study was performed in a tertiary care referral center where the holistic approaches, combined with availability of intensivists, nephrologists and other subspecialties, it leads to a tendency for improved treatment outcomes. Thus, our results might be applied to patients in tertiary care centers in Thailand, but may not represent common practice in all ICUs in other parts of the country. Morever, the number of subjects in the present study is not very large, as we have just initiated PIRRT modalities in our hospital. Therefore, the authors may not able to adequately explain some outcomes of the present study, such as the number of patients with renal recovery or the mortality rate. Further study is needed in larger populations and more variables should be collected in order to pursue a more comprehensive clinical trial which will eventually improve clinical outcomes.

Conclusion

The prolonged intermittent renal replacement therapy (PIRRT), both SLEDD and SLEDD-*f*, appears to be a promising renal replacement therapy for treatment of critically ill patients with acute kidney injury. It provides good efficacy and does not interfere with hemodynamic outcome and it seems to have cost effectiveness and be suitable to limited resource or location such as exists in our country.

Potential conflicts of interest

None.

References

1. Paganini EP, Larive B, Kanagasundaram NS. Severity scores and outcomes with acute renal failure in the ICU setting. Contrib Nephrol 2001; (132): 181-95.
2. Silvester W. Outcome studies of continuous renal replacement therapy in the intensive care unit. Kidney Int Suppl 1998; 66: S138-41.
3. Vanholder R, Van Biesen W, Lameire N. What is the renal replacement method of first choice for intensive care patients? J Am Soc Nephrol 2001; 12 (Suppl 17): S40-3.
4. Mehta RL, Pascual MT, Gruta CG, Zhuang S, Chertow GM. Refining predictive models in critically ill patients with acute renal failure. J Am Soc Nephrol 2002; 13: 1350-7.
5. Kumar VA, Craig M, Depner TA, Yeun JY. Extended daily dialysis: A new approach to renal replacement for acute renal failure in the intensive care unit. Am J Kidney Dis 2000; 36: 294-300.
6. Marshall MR, Golper TA, Shaver MJ, Alam MG, Chatoth DK. Sustained low-efficiency dialysis for critically ill patients requiring renal replacement therapy. Kidney Int 2001; 60: 777-85.
7. Marshall MR, Ma T, Galler D, Rankin AP, Williams AB. Sustained low-efficiency daily diafiltration (SLEDD-f) for critically ill patients requiring renal replacement therapy: towards an adequate therapy. Nephrol Dial Transplant 2004; 19: 877-84.
8. Kielstein JT, Schiffer M, Hafer C. Back to the future: extended dialysis for treatment of acute kidney injury in the intensive care unit. J Nephrol 2010; 23: 494-501.
9. Bellomo R, Ronco C. Indications and criteria for initiating renal replacement therapy in the intensive care unit. Kidney Int Suppl 1998; 66: S106-9.
10. Fieghen HE, Friedrich JO, Burns KE, Nisenbaum R, Adhikari NK, Hladunewich MA, et al. The hemodynamic tolerability and feasibility of sustained low efficiency dialysis in the management of criti-

cally ill patients with acute kidney injury. BMC Nephrol 2010; 11: 32.
11. Cruz DN, Antonelli M, Fumagalli R, Foltran F, Brienza N, Donati A, et al. Early use of polymyxin B hemoperfusion in abdominal septic shock: the EUPHAS randomized controlled trial. JAMA 2009; 301: 2445-52.
12. Kobayashi A, Iwasaki Y, Kimura Y, Kawagoe Y, Ujike Y. Early recovery in hemodynamics after direct hemoperfusion with polymyxin B-immobilized fibers may predict mortality rate in patients with septic shock. J Anesth 2010; 24: 709-15.
13. Kielstein JT, Kretschmer U, Ernst T, Hafer C, Bahr MJ, Haller H, et al. Efficacy and cardiovascular tolerability of extended dialysis in critically ill patients: a randomized controlled study. Am J Kidney Dis 2004; 43: 342-9.
14. Mehta RL, Kellum JA, Shah SV, Molitoris BA, Ronco C, Warnock DG, et al. Acute Kidney Injury Network: report of an initiative to improve outcomes in acute kidney injury. Crit Care 2007; 11: R31.
15. Kumar VA, Yeun JY, Depner TA, Don BR. Extended daily dialysis vs. continuous hemodialysis for ICU patients with acute renal failure: a two-year single center report. Int J Artif Organs 2004; 27: 371-9.

ประสิทธิภาพและผลลัพธ์ทางพลศาสตร์การไหลเวียนเลือดของการฟอกเลือดชนิดไม่ต่อเนื่องนาน 8 ชั่วโมงในผู้ป่วยวิกฤต

รณิษฐา รัตนะรัต, ธัญญรัตน์ ชัยพฤกษ์มาลาการ, นพรัตน์ เลาวหุตานนท์, นัฐสิทธิ์ ลาภปริสุทธิ, สมเกียรติ วสุวัฏฏกุล

***ภูมิหลัง**: ภาวะไตวายเฉียบพลันเป็นภาวะที่พบบ่อยในผู้ป่วยวิกฤต การฟอกไตชนิดไม่ต่อเนื่องโดยใช้ระยะเวลาการฟอกที่นาน (PIRRT) เป็นการฟอกไตชนิดที่นำเอาข้อดีของการฟอกไตชนิดต่อเนื่อง (CRRT) ในด้านการรักษาสมดุลพลศาสตร์การไหลเวียนเลือดและการฟอกไตชนิดดั้งเดิมที่มีราคาถูกเข้าไว้ด้วยกัน การศึกษานี้มีเป้าหมายเพื่อศึกษาผลของการฟอกไตชนิด PIRRT ต่อประสิทธิภาพของการฟอกเลือด และผลลัพธ์ทางพลศาสตร์การไหลเวียนเลือดในผู้ป่วยวิกฤต*

***วัสดุและวิธีการ**: เก็บข้อมูลในผู้ป่วยวิกฤตที่รับการรักษาด้วยการฟอกเลือดวิธี PIRRT ในช่วงเดือนกุมภาพันธ์ พ.ศ. 2552 ถึง กันยายน พ.ศ. 2553 การฟอกเลือดชนิด PIRRT ทำโดยใช้เทคนิค slow low efficiency infiltration (SLEDD) และ slow low efficiency daily diafiltration (SLEDD-f) นาน 8 ชั่วโมง ติดต่อกัน 3 วัน เก็บข้อมูลในด้านผลศาสตร์การไหลเวียนเลือดของผู้ป่วย และเก็บเลือดก่อนและหลังการรักษาเพื่อหาอัตรากำจัดของเสียโดย PIRRT*

***ผลการศึกษา**: มีผู้ป่วยวิกฤตที่มีภาวะไตวายเฉียบพลันรับการรักษาโดยเทคนิค SLEDD 33 ราย และ เทคนิค SLEED-f 27 ราย พบว่าการรักษาทั้ง 2 วิธีทำให้มีการลดลงของระดับยูเรีย, ครีแอทินิน; โปตัสเซียม และฟอสเฟตอย่างมีนัยสำคัญ โดยการรักษาด้วย SLEDD-f มีอัตราการกำจัดของเสียไม่แตกต่างจาก SLEDD ผลทางพลศาสตร์การไหลเวียนเลือดพบว่าค่าเฉลี่ยความดันโลหิตเพิ่มขึ้นหลังการรักษาด้วย PIRRT ในวันแรก และยังคงดีขึ้นอย่างต่อเนื่องในระหว่างการรักษาด้วย PIRRT ตลอด 3 วัน ร่วมกับพบว่า vasopressor score ของผู้ป่วยดีขึ้นตามลำดับ*

***สรุป**: การฟอกไตชนิด PIRRT เป็นวิธีที่มีประสิทธิภาพดีในการรักษาผู้ป่วยวิกฤตที่มีภาวะไตวายเฉียบพลันและเนื่องจากราคาไม่แพงจึงเป็นเทคนิคที่เหมาะสมในภูมิภาคที่มีข้อจำกัดทางด้านเศรษฐกิจเช่นในประเทศไทย*