

# The Efficacy of Single-Needle versus Double-Needle Hemodialysis in Chronic Renal Failure

Thananda Trakarnvanich MD\*,  
Thanit Chirananthavat MD\*\*, Sunanta Ariyakulnimit RN\*\*,  
Pakamas Maneerat RN\*\*, Suwanna Chabsuwan RN\*\*

\* Renal Unit, Department of Medicine, Bangkok Metropolitan Administration Medical College and Vajira Hospital

\*\* Renal Unit, Department of Medicine, Police General Hospital

---

**Objective:** The purpose of the present study was to assess single-needle dialysis adequacy and other parameters of dialysis efficiency, such as recirculation, hematocrit, calcium and phosphorus level. The complications and adverse events were also evaluated. Time to achieve maximal adequacy of dialysis were compared between 4, 4.5, and 5.0 hours of dialysis session.

**Design:** Prospective, cross-over trial.

**Setting:** Renal Unit, Department of Medicine, Bangkok Metropolitan Administration Medical College and Vajira Hospital

**Material and Method:** Seven stable chronic renal failure patients who regularly used standard hemodialysis (HD) technique with double-needle (DN) were recorded for baseline data including Kt/V, percent recirculation, calcium and phosphorus level, hematocrit, and LDH level. Subsequently, all the patients were placed on single-needle dialysis (SN) for 3 consecutive duration, 4 hours, 4.5 hours and 5.0 hours respectively for 3 weeks in each period. The same parameters were recorded at the end of each period.

**Results:** Prior to the single-needle phase, the adequacy of dialysis in DN dialysis were within the acceptable range. After switching to SN mode, the Kt/V did not change significantly from the baseline value. However, subgroup analysis in twice weekly dialysis revealed some degree of reduction in Kt/V value albeit not significant. In the thrice weekly group, the Kt/V did not differ from the baseline value and achieved the target level according to the DOQI guideline. The other parameters such as hematocrit, calcium, phosphorus and LDH were not different from the DN group. SN dialysis did not cause more recirculation than the DN group and both were less than 10 percent. There were no other major complications during the SN phase. The outcome of the fistulas were excellent

**Conclusion:** The SN dialysis has the same efficacy as the conventional DN technique in terms of Kt/V and other parameters such as calcium, phosphorus and LDH values. Both DN and SN caused less than 10% recirculation. There were no reports of adverse events during the treatment period. The double-pump system therefore could be suitable for routine thrice weekly HD in a selected group of patients.

**Keywords:** Single-needle dialysis, Adequacy of dialysis

**J Med Assoc Thai 2006; 89 (Suppl 2): S196-206**

**Full text. e-Journal:** <http://www.medassocthai.org/journal>

---

Single-needle (SN) dialysis was first described by Twiss in 1964 using a time-activated mechanism with a pump and a double clamp for the alternating flow

Correspondence to : Trakarnvanich T, Renal Unit, Department of Medicine, Bangkok Metropolitan Administration Medical College and Vajira Hospital, 681 Samsen Rd, Bangkok 10300, Thailand. Phone & Fax: 0-2244-3469. E-mail: thtrm@samart.co.th

of blood along a caval catheter<sup>(1)</sup>. Kopp et al<sup>(2)</sup> used blood line clamps controlled by a pressure-activated system. Hilderson et al<sup>(3)</sup> also used a pressure-activated system that controlled a double-headed blood pump. SN provides an alternative way of using vascular access and offer specific advantage in terms of patient benefit that helps prolong fistula survival and limit fistula-related complications. Its use, however, has not

been widespread and has been confined to specific situations<sup>(4)</sup>. The low general utilization of this technique may be attributed to a number of factors that include poor understanding of the technique, the reluctance to adopt new techniques when established alternatives exist, and the widely held belief that SN dialysis is inferior to conventional double-needle (DN) dialysis. This is principally due to the presence of recirculation, as well as the inability to obtain clinically acceptable blood flow rates with single-pump tidal flow systems.

Vanholder et al<sup>(5)</sup> reported 76 patients in their hospital programs that were routinely treated using a commercially available twin-pump head SN system. They found that the dialysis efficiency calculated as Kt/V was at least as good as the DN technique. Other parameters, such as hematocrit and nerve conduction velocity during 2 years of follow up were at least as good as in the DN technique. Five years' fistula survival rate was 74%, a value higher than studies on DN dialysis. The cumulative survival rate was comparable to the survival of EDTA registry report. This author concluded that, provided adequate fistula flow and dialyzer blood flow are available, the urea kinetic on SN dialysis was comparable with values observed in DN dialysis patients.

Despite these potential advantages, SN dialysis is scarcely used in many countries including Thailand. With new modern devices such as the Fresenius 4008 H machine with double head pump system for SN dialysis, the authors can use this model more easily.

The purpose of the present study was to compare the SN dialysis, using the Fresenius 4008 H machine with the conventional DN hemodialysis (HD). The comparison was in term of clearance, recirculation, potential adverse effects (such as hemolysis, air embolism) and fistula survival in Thai chronic renal failure patients. The authors also determined the optimal duration of the HD session in order to achieve adequacy of dialysis.

#### ***Benefit of the study***

Since there are no report data regarding SN dialysis in Thailand, the present study will be the first clinical data proving the potential feasibility of this technique. If this technique can be shown equally effective as conventional DN HD, it may be another option for some patients. The patient will gain benefits by virtue of preserving vascular access, lessen the number of punctures during HD and help to reduce overall discomfort.

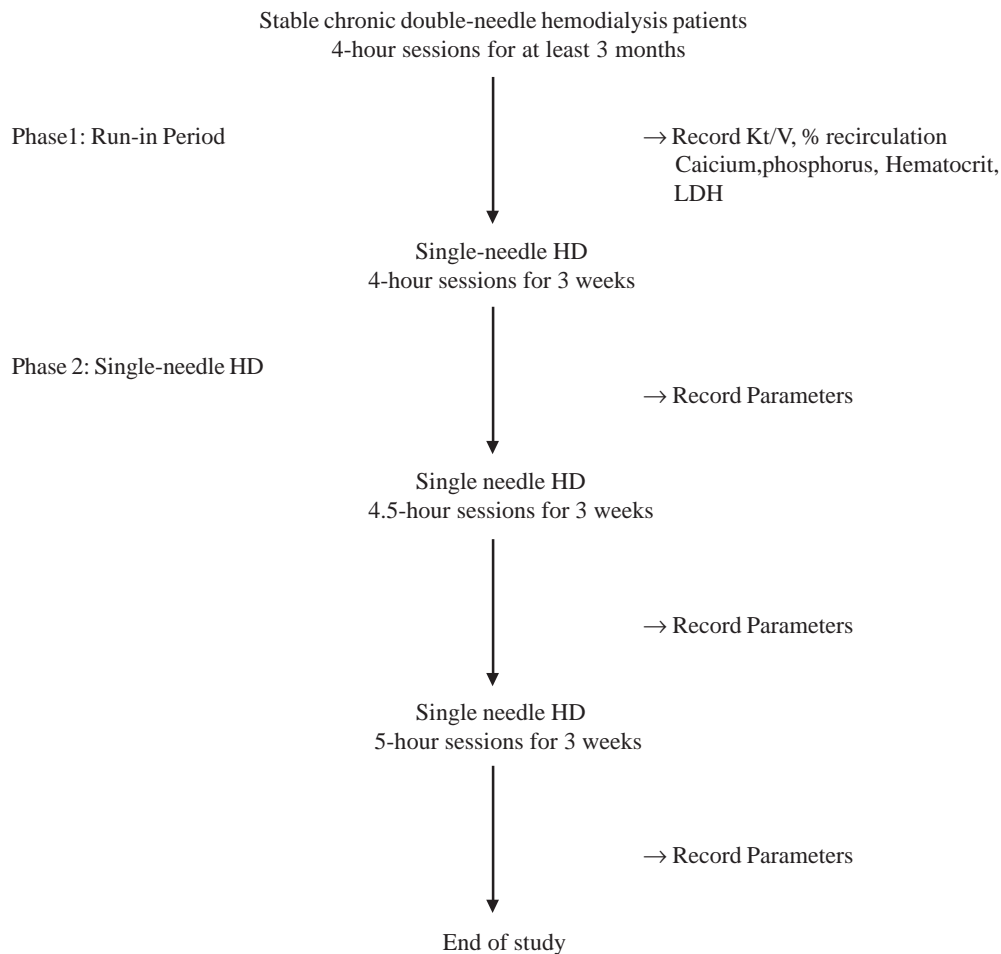
#### **Material and Method**

From January 2005 to March 2006, a total of 7 patients diagnosed as End Stage Renal Disease (ESRD) and were on regular DN HD for at least 3 months before the present study was undertaken were enrolled. Informed consents were obtained. The present study was conducted according to good clinical practice guidelines and was approved by the Bangkok Metropolitan Administration Ethical Committee. Eligible patients were defined as follows: age more than 15 years, creatinine clearance less than 5 ml/min, stable dry weight, ambulatory care, adequate access blood flow at least 200 ml/min, (vascular access may be native arterio venous fistula (AVF) or poly tetrafluoroethylene (PTFE) graft. The exclusion criterion were inadequate fistula blood flow, access recirculation more than 15%, large body size (BMI > 20), phosphorus level more than 10 mg/dl, and had concurrent illnesses.

All patients were dialyzed using the volume control dialysis delivery system. The authors divided the patients into two phases (Fig. 1). Phase 1 was the run-in period: using conventional DN HD at the same weekly frequency using F60 dialyzer (Fresenius, Germany). The authors measured Kt/V, access recirculation, blood chemistry (lactic dehydrogenase level, calcium, phosphorus) as baseline values. Phase 2 was the SN period: the SN HD was performed using a Fresenius 4008H HD machine with double-headed pump. 17-gauge SN cannulas (Happy Cath, Medikit Co., LTD, Tokyo, Japan) that allowed blood flow rate up to 250 ml/min were used. In phase 2, all patients were dialyzed for 4-hour sessions thrice a week for 3 weeks, then 4.5-hour sessions thrice a week for 3 weeks and 5-hour sessions thrice a week for 3 weeks. A mean blood flow rate (about 300 ml/min) was maintained constantly throughout the study. The stroke volume was fixed to 30 ml. In addition to the same parameter recorded in phase 1, the following additional parameters were recorded at the end of each session; blood flow rate, dialysate flow, and volume removed per session. All complications were also recorded as fistula-related or technically related.

The Kt/V values, as markers of HD adequacy, were calculated by the second generation of natural logarithm formula of Daugirdas as follows<sup>(6)</sup>

$$\begin{aligned} Kt/V &= -\ln(R - 0.008 \times t) + (4 - 3.5 \times R) \times UF/W \\ R &= Ct/C0 \\ Ct &= \text{post-dialysis BUN (mg/dl)} \\ C0 &= \text{pre-dialysis BUN (mg/dl)} \\ \ln &= \text{natural logarithm} \\ t &= \text{HD time (hour)} \end{aligned}$$



**Fig. 1** Study protocol

UF = quantity of ultrafiltrate (L)  
W = post-dialysis weight (Kg)

According to DOQI guideline recommendation, the authors used the 15-second post-dialysis BUN by slow flow/stop pump technique (decreased blood flow rate to 120 ml/min for 10 minutes then stop pump) as post-dialysis BUN in Daugirdas formula<sup>(7)</sup>. This BUN values prevented sample dilution with recirculated blood and minimized the confounding effects of urea rebound. The Kt/V values from this method were used to compare the efficacy of DN to SN HD in different session time.

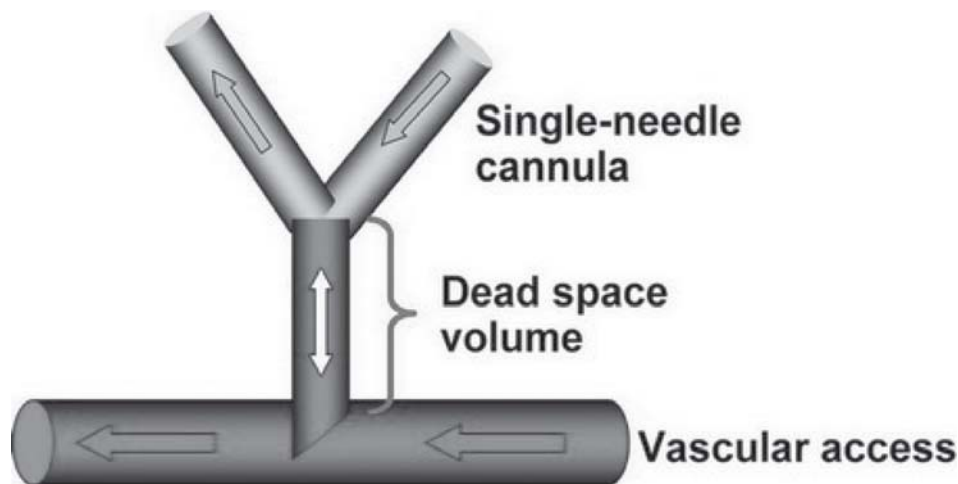
The access recirculation (AR) caused by the dialyzed blood from venous line of vascular access was recirculated to arterial line of access DN dialysis. The authors measured the access recirculation in the SN technique that used only one needle as the route

for blood entering in and out from the patients. Unlike DN HD blood was removed and returned at the same point of access. The access recirculation was determined by slow flow-stop pump technique (decreased blood flow rate to 120 ml/min for 10 minutes then stop pump) after dialysis started for 30 minutes and calculated the AR values by this equation.

$$\%AR = [(s-a) / (s-v)] \times 100$$

a = arterial BUN at operative blood flow (mg/dl)  
v = venous BUN at operative blood flow (mg/dl)  
s = arterial BUN after stop pump (mg/dl)

In SN dialysis, the extracorporeal circuit recirculation (ECR) type of recirculation is inevitable. ECR is the recirculation typically happening only in SN dialysis and is caused by the retained purified blood within the needle and the distal catheter (Fig. 2). This is the common pathway and also the dead space in the



**Fig. 2** Dead space volume of single-needle cannula

venous cycle. In the arterial phase, blood within the dead space will be returned to the extracorporeal circuit and cause the ECR. The needle the authors used in the present study had a dead space of 1.3 ml.

The authors calculated the ECR as the following equation: %ECR = (dead space volume/stroke volume) × 100.

#### Statistical analysis

All parameters are reported as mean ± standard deviation. Comparison of Kt/V among treatment group was calculated using Friedman test (repeated measurement ANOVA) and McNemar tests were performed in category data and Wilcoxon Signed Ranks test were used to compare between treatment group with  $p < 0.05$  was considered as statistically significant.

### Results

#### Patients characteristics

Table 1 shows the basic clinical characteristics of the patients who were recruited into the present study. The study sample consisted of 7 HD patients, 4 females and 3 males, mean age 55 years (range 36-74 years). Causes of renal failure included diabetes mellitus (3), hypertensive nephrosclerosis (1), chronic glomerulonephritis (2) and interstitial nephritis (1). The mean hematocrit was 29.9% (range 24.9-37.7%), lactic dehydrogenase level (LDH) 452.29 IU/ml (range 223-1184 IU/ml), calcium 10.64 mg/dl (range 8.40-13.40 mg/dl) and phosphorus level were 4.87 mg/dl (range 2.70-6.80 mg/dl). Five of the patients (71.4%) were maintained on thrice weekly dialysis and two cases (28.6%) were on

twice weekly HD. The mean treatment times were 4 hours. The average duration of dialysis was 71.3 months (range 51-91 months) and all of the patients had native arteriovenous fistula. There were no clinical complications during SN HD in all patients.

#### Adequacy of dialysis and recirculation

Table 2 summarizes the adequacy of dialysis by using the second generation of the natural logarithm of Daugirdas formula. The data represented the mean Kt/V as a whole group. The baseline Kt/V in the DN group were within the acceptable range, more than 1.8 in twice weekly dialysis session and more than 1.2 in thrice weekly dialysis in all patients. After switching to SN dialysis, the Kt/V declined in the 4-hr group slightly but rose to the level comparable to the DN method in the 4.5 hr and the 5 hr session (Fig. 3). The value in the

**Table 1.** Patient demographics

Detail	Value
Age [y]	55.6±12.5
Sex [M/F]	4/3
Duration of dialysis [month]	71.3±12.8
Frequency of dialysis in a week	2/wk 2
	3/wk 5
Case of ESRD	DM 3
	HT 1
	Chronic GN 2
	Interstitial nephritis 1

Value expressed as mean ± SD or number of patients

**Table 2.** Comparison between Kt/V in four different treatment groups

Treatment	N	Mean	SD	p-value*
DN	7	1.74	0.17	0.168
SN4	7	1.47	0.59	
SN4.5	7	1.74	1.43	
SN5	7	2.06	1.01	

Friedman test (Repeated measurement ANOVA)

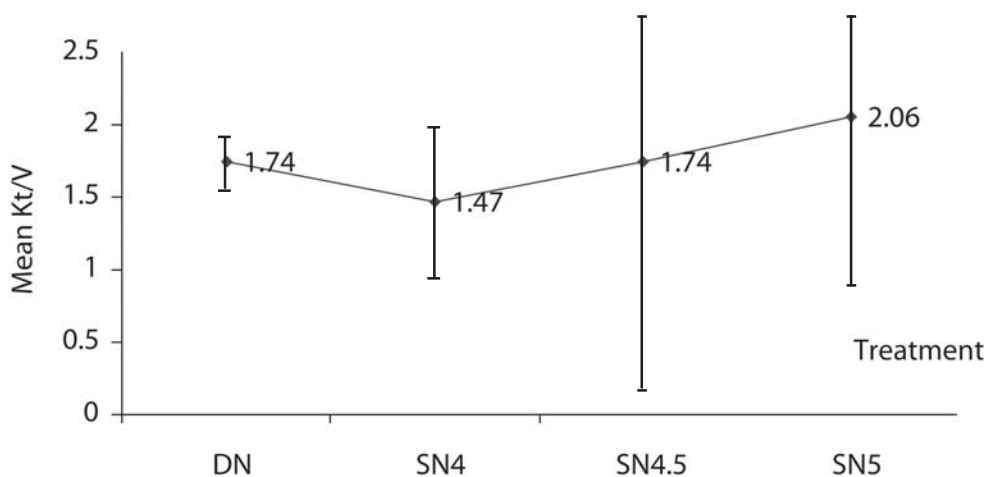
DN Double-needle dialysis

SN 4 Single-needle dialysis 4 hour

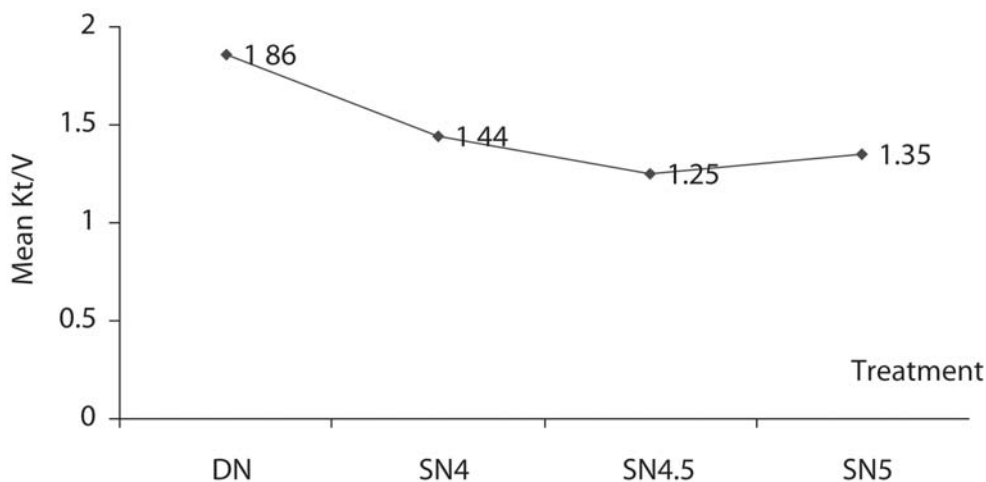
SN 4.5 Single-needle dialysis 4.5 hour

SN 5 Single-needle dialysis 5.0 hour

5-hr session was highest when compared with the DN and all other SN treatment. The mean weekly Kt/v values between each group were not statically significant when compared by nonparametric analysis. Further analysis into the subgroup according to the frequency of dialysis session per week showed that mean Kt/V in the twice weekly group had the tendency to decline, but did not reach statistical significance (Fig. 4). However, the value of the Kt/V in the twice weekly group did not meet the target guideline as described by DOQI (Kt/V more than 1.8 per week). On the other hand, the thrice weekly group had mean Kt/V above the target point (more than 1.2 per week) at all treatment periods (Fig. 5). In addition, the value rose progressively from



**Fig. 3** Comparison of mean Kt/V ± SD in four different treatment groups (p = 0.168)



**Fig. 4** Mean Kt/V in twice weekly dialysis group (No statistically significant different, p = 0.241)

4 to 4.5 and 5-hr in SN session although not statistically significant.

The baseline recirculation values were within normal limits, less than 10 percent. After switching to SN dialysis, the authors measured the extracorporeal circuit recirculation as the equation described above

$$\% \text{ ECR} = (1.5/30) \times 100 = 5\%$$

This value was added to the access recirculation to become total recirculation in SN dialysis. Mean of recirculation in all treatment groups is shown in Table 3-4. The recirculation was increased in SN compared to DN HD and reached statistical significance in the 4 and 4.5-hr session compared to the DN group.

However, the absolute value was still below 10% in all patients (Fig. 6).

**Other parameters**

The mean hematocrit at baseline in this dialysis population averaged 29.90% and had no significant changes after switching to SN dialysis (Table 5). The mean level of hematocrit in SN studies at 4 was 28.4%, at 4.5hr was 26.69% and at 5-hr was 26.23% ( $p = 0.054$  compared to baseline values). Although the level declined progressively in the SN group, this did not reach statistical significance ( $p = 0.054$ ).

The level of the calcium and phosphorus were not significantly changed when compared between

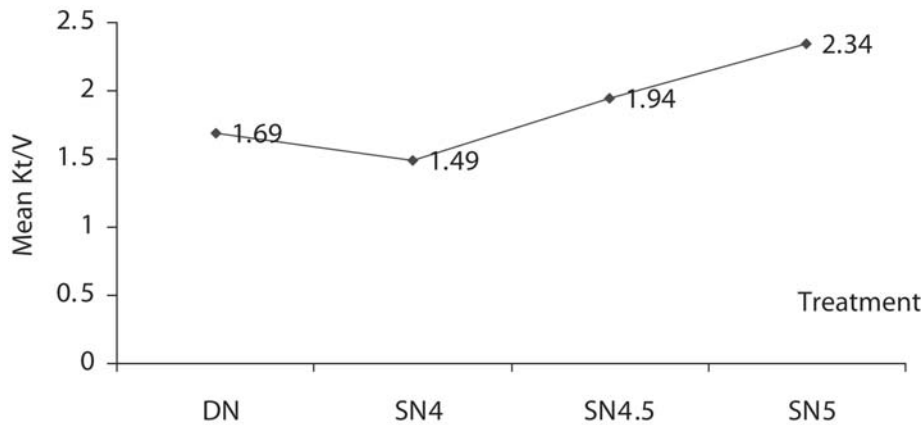


Fig. 5 Mean Kt/V in thrice weekly dialysis group (No statistically significant different  $p = 0.323$ )

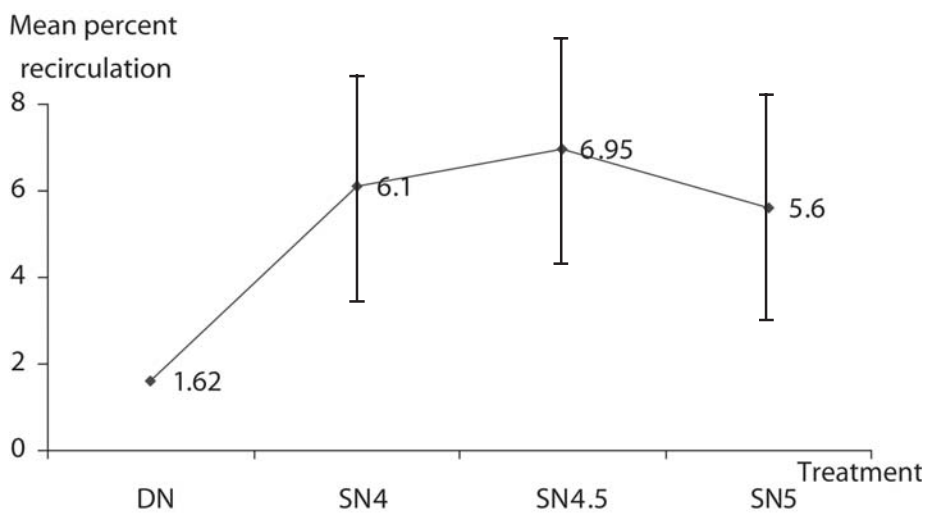


Fig. 6 Percent recirculation in each treatment group (significant difference at SN4 and 4.5 compare to DN and between SN4.5 and SN5)

the two modalities (Table 6). The mean calcium level in the DN group was 10.64 mg/dl and was 10.20 mg/dl at 4hr, 9.67 mg/dl at 4.5hr and 9.57 mg/dl at 5.0-hr sessions in the SN group ( $p = 0.208$ ). The mean phosphorus level in the DN group was 4.87 mg/dl and were 5.34, 4.97 and 4.97 mg/dl in the SN dialysis 4, 4.5 and 5.0-hr sessions respectively ( $p = 0.540$ ) (Table 7).

The upper limit of lactic dehydrogenase (LDH) level in the present study was 460 IU/ml. 71.4% in the DN group had the mean LDH values within the normal range. After changing to SN treatment, the proportion of patients that had LDH value within normal range was not statistically significant when compared with the DN technique. This is also true when compared to the 4.5 and 5.0-hr sessions (Table 8). The mean percent

increase in LDH value compared to the DN group was 50.85% in the 4-hr session but only 4.39% and 7.53% in 4.5 and 5-hr SN sessions (Fig. 7) respectively. Similarly, the percent of dialysis sessions associated with more than 20% increase in LDH values were maximum when compared between DN and SN4 (57.1%) and declined to 14.3% and 28.6% when compared between DN and SN 4.5 and 5-hr sessions, but did not reach statistical significance (Table 9).

#### Fistula survival and other complication

During the treatment period and follow up 6-12 months after, all of the patients had excellent fistula potency. No other side effects were found. All of the patients tolerated the treatment well.

#### Discussion

Described more than 30 years ago, the technique of SN HD has become familiar to many dialysis units especially in Belgium and some European coun-

**Table 3.** Percent recirculation in each treatment group

Treatment	N	Mean	SD	p-value*
DN	7	1.62	2.78	0.011
SN4	7	6.10	1.86	
SN4.5	7	6.95	2.12	
SN5	7	5.60	1.58	

\* Friedman test (Repeated measurement ANOVA)

**Table 4.** Comparison of percent recirculation between each treatment group. There were statistically significant differences between DN and SN 4, and DN with SN 4.5

Treatment	Compare p-value of Kt/V between group		
	SN4	SN4.5	SN5
DN	0.028*	0.018*	0.058
SN4		0.499	0.249
SN4.5			0.043

\* Wilcoxon Signed Ranks test Significant at p value less than 0.05

**Table 5.** Mean hematocrit values

Treatment	N	Mean	SD	p-value*
DN	7	29.90	4.28	0.054
SN4	7	28.41	5.31	
SN4.5	7	26.69	6.42	
SN5	7	26.23	6.07	

Friedman test (Repeated measurement ANOVA)

**Table 6.** Mean calcium level

Treatment	N	Mean	SD	p-value*
DN	7	10.64	1.74	0.208
SN4	7	10.20	1.18	
SN4.5	7	9.67	0.77	
SN5	7	9.57	1.36	

\* Friedman test (Repeated measurement ANOVA)

**Table 7.** Mean phosphorus level

Treatment	N	Mean	SD	p-value*
DN	7	4.87	1.50	0.540
SN4	7	5.34	1.93	
SN4.5	7	4.97	1.74	
SN5	7	4.97	1.69	

\* Friedman test (Repeated measurement ANOVA)

**Table 8.** LDH value in different group of treatment

Treatment	LDH $\leq$ 460 n (%)	LDH > 460 n (%)	Total n (%)
DN	5 (71.4%)	2 (28.6%)	7 (100%)
SN4	4 (57.1%)	3 (42.9%)	7 (100%)
SN4.5	5 (71.4%)	2 (28.6%)	7 (100%)
SN5	5 (71.4%)	2 (28.6%)	7 (100%)

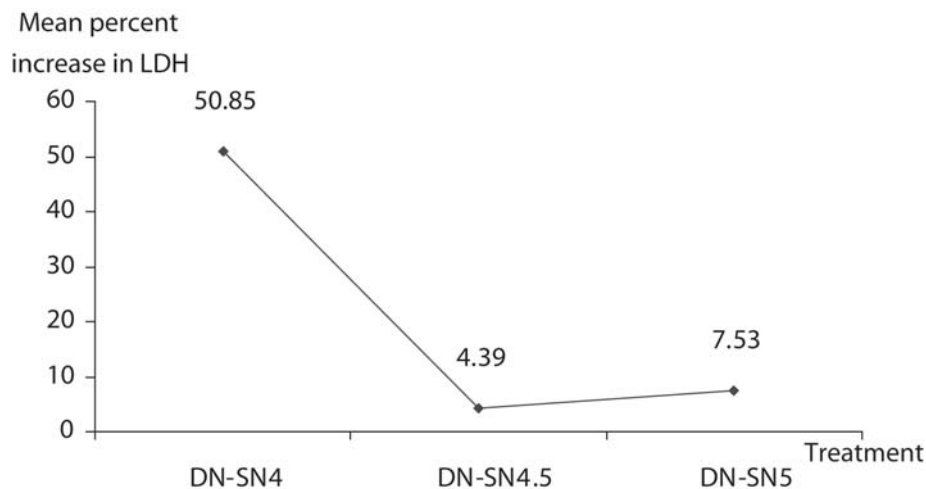


Fig. 7 Mean percent increase in LDH from DN to SN

Table 9. Proportions of patients who had 20 % increase in LDH

	≤ 20% increased LDH		> 20% increased LDH	
	No.	%	No.	%
DN_SN4	3	42.9	4	57.1
DN_SN4.5	5	71.4	2	28.6
DN_SN5	5	71.4	2	28.6
SN4_SN4.5	6	85.7	1	14.3
SN4_SN5	6	85.7	1	14.3
SN4.5_SN5	5	71.4	2	28.6

tries. The original mechanical system was a pressure-time controlled pump. This system has problems due to single pump tidal flow system however, it is more convenient and can be adapted for other HD modalities such as hemofiltration, hemodiafiltration and plasmapheresis<sup>(8)</sup>.

The efficiency of the SN system is dependent on the mean blood flow and the amount of the recirculation. This is mainly caused by the compliance of the tubing system. Blumenthal et al<sup>(9)</sup> studied inflow time and recirculation in SN HD and found that percentage recirculation decreased progressively from 23% ± 3% at an inflow time of 1 second to 7% ± 2% at inflow time of 4 seconds ( $p < 0.03$ ,  $n = 5$ )<sup>(10)</sup>. With a time-time SN device, (Gambro SN-10-21) recirculation did not vary with a change in pump speed from 106 to 250 ml/min (8.2% vs 8.4%,  $n = 6$ ). With a Drake Willock (pressure-time) device, inflow time varied with pump inversely with pump speed; at higher pump speeds, recirculation

tended to increase. They concluded that minimum recirculation appeared to be associated with an optimal inflow time of 4 seconds when time-time single needle devices were used. The highest possible stroke volume and the shortest tubing are to be used to reduce the effect of recirculation.

The potential hazards when using a SN system are principally the same as those for conventional DN extracorporeal circuits. As example of these hazards are the blood loss to the environment due to a rupture or disconnection of the bloodline, and air embolism. Hemolysis from shear stresses between red cells and the needle or catheter also is an important complication especially if flows are too high<sup>(8)</sup>. The technique should always be used with needles with a large enough diameter. The chances for back filtration with the fluctuations in pressure are also more substantial than for two needle dialysis. Therefore SN dialysis should be done with ultrapure dialysate.



With the advent of the new Fresenius 4008 H machine with double-pump SN module, the authors studied single needle dialysis in Thai chronic renal failure patients undergoing regular HD compare with conventional DN dialysis (cross-over study). Comparison in terms of dialysis adequacy, clearance, recirculation and complications will be done. This is the first study on SN dialysis in Thailand.

In the present study, the authors found that the adequacy of dialysis in the SN dialysis is as effective as the DN group. Although the Kt/V in the 4-hr session declined somewhat, this did not reach statistical significance. The mean Kt/V increased when the duration of the dialysis increased. The adequacy in the 5-hr was the best. As expected, twice weekly dialysis using SN technique caused insufficient Kt/V to approach the target value even though the Kt/V did not differ significantly from the DN group ( $p = 0.241$ ). In thrice weekly dialysis, the Kt/V values in the SN group were comparable to the DN at every time point. Therefore, the authors would not recommend SN dialysis twice weekly. In SN group, the frequency of dialysis should be at least 4 hours.

One of the undesirable effects of SN dialysis is recirculation. This is mainly caused by the compliance of the tubing system. As the authors mentioned, the ECR is inherent in all systems of SN dialysis. During the venous phase, the dialysed blood is pressed into the arterial cycle together with the additional blood that is sucked from the venous branch. In the present study, the ECR was calculated as 5%. Recirculation was determined in both groups of treatment and were both within normal range (less than 10%) although the recirculation in SN was higher compared to the DN group. This should be explained from the ECR in SN dialysis. As stated by Vanholder et al, recirculation rate of 14% reduced dialyzer urea clearance only by 8.2%<sup>(5)</sup>. The relative influence of recirculation on dialyzer performance is mostly overemphasized since clearance is not reduced by the amount equal to the measured recirculation. The authors did not correct the recirculation for the clearance data since the recirculation in the present study did not reach detrimental level.

The slight reduction of mean hematocrit in the SN group may be due to subclinical hemolysis. This coincides with an increase in lactic dehydrogenase level. The mean LDH in DN group was slightly high but when changed to SN technique, the values did not increase significantly. Hemolysis was assumed to originate from the high blood flow rate exposed blood cells to excessive pressures and shear stresses that

occurred more than in DN dialysis. The cannula itself represents an important factor determining the pressures acting on the red blood cells. Therefore choosing the proper large lumen cannula and use of the double-pump devices as in the present study help to control the pressure in both arterial and venous line and reduce the incidence of hemolysis.

The present study assessed the parameters used to predict the adequacy of dialysis, the calcium and phosphorus level. Both were comparable to the DN group. The fistula survival was also excellent and no fistula-related complications were found.

The present study has some limitations. First, the sample size was too small especially in the twice-weekly subgroup. Second, the time interval to follow up in the SN phase should be longer to evaluate the difference between groups. Finally, proper time to collect the blood sample for calculating the Kt/V should be reevaluated to correct the effect of urea rebound, the 30-minute post-dialysis BUN as equilibrated BUN for the values of post-dialysis BUN may be the proper value to get equilibrated Kt/V.

The benefit of SN dialysis is minimizing the risk of fistula damage and destruction since the vascular access will be punctured only once in each session. This will also help to reduce patient discomfort. SN dialysis can also be used in acute dialysis where blood access is made through a single venous catheter. By improving the design of the machine, proper selection of the cannula and setting the maximum blood flow rate to achieve the target Kt/V and avoid hemolysis would be of the utmost importance and give the best results to the patients.

In conclusion, in the authors' experience, SN dialysis option may be reconsidered as an alternative mode of renal replacement therapy in a selected group of patients. The adequacy of dialysis was comparable to DN dialysis in the thrice weekly group. Other parameters were also not different and were as good as the DN group. The belief that efficient SN dialysis is not possible should be reconsidered.

#### **Acknowledgements**

The authors wish to thank Ms. Weena Pinichwattana for assistance in statistical analysis and for all the HD staffs and the patients in the Renal Unit, Department of Medicine Bangkok Metropolitan Administration Medical College and Vajira Hospital for helping to complete the project. This work was supported by a grant from the Research Fund, Bangkok Metropolitan Medical College and Vajira Hospital.

## References

1. Twiss EE. One-cannula haemodialysis. *Lancet* 1964; 17: 1106.
2. Kopp KF, Gutch CF, Kolff WJ. Single needle dialysis. *Trans Am Soc Artif Intern Organs* 1972; 18: 75-81.
3. Hilderson J, Ringoir S, van Waelegem JP, van Egmond J, van Haelst JP, Schelstraete K. Short dialysis with a polyacrylonitrilmembrane (RP 6) without the use of a closed recirculating dialyzate delivery system. *Clin Nephrol* 1975; 4: 18-22.
4. Vanholder R, Hoenich N, Ringoir S. Single needle hemodialysis. In: Maher JF, editor. *Replacement of renal function by dialysis*. 3<sup>rd</sup> ed. Boston: Kluwer Academic Publisher; 1989: 382-99.
5. Vanholder R, Hoenich N, Ringoir S. Adequacy studies of fistula single-needle dialysis. *Am J Kidney Dis* 1987; 10: 417-26.
6. Daugirdas JT. Simplified equations for monitoring Kt/V, PCRn, eKt/V, and ePCRn. *Adv Ren Replace Ther* 1995; 2: 295-304.
7. National Kidney Foundation. I. NKF-K/DOQI Clinical practice guidelines for hemodialysis adequacy: update 2000. *Am J Kidney Dis* 2001; 37: S7-64.
8. Polaschegg H. Single-needle dialysis. In: Nissenson AR, Fine RN, editors. *Dialysis therapy*. 3<sup>rd</sup> ed. Philadelphia: Hanley & Belfus; 2002: 65-8.
9. Blumenthal SS, Ortiz MA, Kleinman JG, Piering WF. Inflow time and recirculation in single-needle hemodialysis. *Am J Kidney Dis* 1986; 8: 202-6.
10. Dhaene M, Gulbis B, Lietaer N, Gammar N, Thayse C, Ooms HA, et al. Red blood cell destruction in single-needle dialysis. *Clin Nephrol* 1989; 31: 327-31.

---

## การเปรียบเทียบประสิทธิภาพระหว่างการฟอกเลือดด้วยวิธีเข็มเดียวและการใช้สองเข็มในผู้ป่วยไตวายเรื้อรัง

ธนันดา ตระการวณิช, ธนิต จิรนนท์ธวัช, สุนันทา อริยกุลนิมิตร, ผกามาศ มณีรัตน์, สุวรรณ ฉาบสุวรรณ

**วัตถุประสงค์:** เพื่อเปรียบเทียบความเพียงพอของการฟอกเลือดและตัวชี้วัดอื่นๆ ที่บ่งบอกถึงประสิทธิภาพของการฟอกเลือด ได้แก่ recirculation, ระดับแคลเซียม, ฟอสฟอรัส และค่าฮีมาโตคริต ระหว่างการทำการฟอกเลือด โดยใช้เทคนิคเข็มเดียวและสองเข็ม

**วัสดุและวิธีการ:** ทำการศึกษาในผู้ป่วยไตวายเรื้อรัง 7 รายที่ได้รับการรักษาด้วยการฟอกเลือดแบบวิธีดั้งเดิม คือ สองเข็ม (DN) เก็บข้อมูลตัวแปร ได้แก่ ค่าความเพียงพอของการฟอกเลือด ( $Kt/V$ ), ร้อยละของ recirculation, ระดับของฮีมาโตคริต, แคลเซียม, ฟอสฟอรัส และ LDH หลังจากนั้นเปลี่ยนเป็นทำการฟอกเลือดแบบเข็มเดียว (SN) 3 ช่วง คือ 4 ชั่วโมง, 4.5 ชั่วโมง และ 5 ชั่วโมง ช่วงละ 3 สัปดาห์ตามลำดับ ทำการบันทึกดัชนีต่าง ๆ เช่นเดียวกับ ขณะฟอกเลือด โดยใช้วิธีสองเข็มเมื่อสิ้นสุดแต่ละช่วง

**ผลการศึกษา:** ผู้ป่วยทุกรายที่เข้าทำการศึกษา มีระดับความเพียงพอของการฟอกเลือดอยู่ในเกณฑ์ที่ยอมรับได้ เมื่อเปลี่ยนเป็นใช้วิธีการฟอกแบบเข็มเดียว พบว่า ค่าเฉลี่ยของ  $Kt/V$  ไม่แตกต่างจากค่าเดิมอย่างมีนัยสำคัญ (1.74 ใน DN และ 1.47, 1.74 และ 2.06 ใน SN 4.0, 4.5 และ 5.0 ชั่วโมงตามลำดับ,  $p = 0.168$ ) อย่างไรก็ตาม ค่า  $Kt/V$  ในกลุ่มที่ฟอกเลือดสัปดาห์ละ 2 ครั้งต่ำลงจากวิธี DN แต่ไม่มีนัยสำคัญ ในขณะที่ค่า  $Kt/V$  ในกลุ่มที่ฟอก 3 ครั้งต่อสัปดาห์ ไม่แตกต่างจากวิธี DN อย่างมีนัยสำคัญทางสถิติ

พบว่าค่าตัวแปรอื่น ๆ เช่น ฮีมาโตคริต, ระดับแคลเซียม, ฟอสฟอรัส และ LDH ไม่แตกต่างกันทั้ง 2 วิธี การฟอกเข็มเดียวไม่ได้ทำให้ค่า recirculation เพิ่มขึ้นอย่างมีนัยสำคัญ ไม่พบว่าภาวะแทรกซ้อนใด ๆ เกิดขึ้นระหว่างทำการศึกษาวิจัยและสภาพของเส้นเลือดของผู้ป่วยที่ใช้แทงอยู่ในสภาพดี

**สรุป:** การรักษาด้วยวิธีฟอกเลือดแบบเข็มเดียว ได้ผลดีเทียบเท่ากับการฟอกแบบสองเข็ม แต่ควรเป็นการฟอกสัปดาห์ละ 3 ครั้งจึงจะเพียงพอ และการฟอก 4, 4.5 และ 5 ชั่วโมงได้ผลดีเท่ากัน ข้อดีของการรักษาวิธีนี้คือ ผู้ป่วยไม่ต้องเจ็บตัว โดนแทงเข็มถึง 2 ครั้งในคราวเดียว และยังเป็นกรถนอมเส้นเลือดไว้ใช้ในระยะเวลาอีกด้วย

---