DOUBLE LUMEN CATHETERS
RECIRCULATION IN PATIENTS UNDERGOING HEMODIALYSIS

ORIGINAL
PROF-1735

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ABSTRACT... Objective: To measure recirculation by Urea based Method in double lumen catheters in patients undergoing hemodialysis. **Design:** Cross sectional study. **Place and duration of study:** Hemodialysis unit of Nephrology department of Shaikh Zayed Hospital, Lahore, and Quaid- i-Azam Medical College Bahawalpur for period of eight months from October 2007 to May 2008. **Patients and methods:** Total 125 adult patients selected with Non probability purposive sampling technique in which hemodialysis were done through double lumen catheter, were studied for recirculation. Access recirculation by urea based method with three sample technique was calculated from following formula; Percentage Recirculation= Systemic (S) – Arterial (A)/ systemic – Venous (V) x 100. **Results:** Out of 125 patients 53 (42%) were males, whereas 72 (58%) were females. Their mean age was 43.4 ± 15.7 years. Percentage recirculation by urea based method was 10.3± 6.64 with range from 3.6 to 24.8. **Conclusions:** Our results have shown the upper limit of acceptable recirculation (10.3± 6.6) through double lumen catheter. Central venous catheter remains an important temporary access and in some cases the only achievable access for the patients. This recirculation should be considered when measuring adequacy level in these patients.

Key words: Double Lumen Catheters, Hemodialysis

INTRODUCTION

Dialysis is of two types; peritoneal dialysis and hemodialysis. Peritoneal dialysis does not need vascular access. Hemodialysis needs access to large blood vessels capable of supplying rapid extracorporeal blood flow. Immediate and temporary access to the circulation is easily achieved by percutanous insertion of dual lumen dialysis cathter[1,2]. The Vascular Access Committee of the NKF-K/DOQI recommends the double lumen catheter for temporary vascular access[3]. Hemodialysis delivery depends on dialysis prescription. Many patients are underdialysed due in part problem in vascular access recirculation, resulting in dialysis delivery being less than that being prescribed[4]. Access recirculation is defined as during haemodialysis, some of the blood that enters the dialyzer inlet may have flowed from outlet without passing first through peripheral capillaries[5]. Access recirculation may cause reduction in effective solute clearance and is special cause of flow dependant disequilibrium[6]. There are multiple factors responsible for recirculation like venous outflow obstruction, central venous stenosis, and close proximity of dialysis needles, accidental reversal of arterial and venous needle and when the blood pump speed exceeds the flow rate[7]. There are various methods to measure the access blood flow and recirculation like urea based method, ultrasound dilution, duplex Doppler, thermodilution and ionic dialysance[8]. Many studies have compared these techniques and have concluded that two needle, urea based method or non-urea based dilutional methods (if available) are the preferred methods for measuring the access recirculation[9].

Double-lumen, non-cuffed, non-tunneled hemodialysis catheters have become the preferred method for obtaining acute hemodialysis vascular access. They are available from many manufacturers and are composed of many different materials. The current polymers are rigid at room temperature to facilitate insertion but soften at body temperature to minimize vessel trauma and blood vessel laceration. Because of close proximity of the arterial and venous ports on these catheters, concern about the extent of recirculation is appropriate. The basis for the recirculation observed in these catheters may be related to the retrograde blood flow present in the central veins following atrial contraction9. Access recirculation in double lumen catheter also depends upon the length of catheter and site[10].

Large proportion of our patients with advanced renal disease is being dialyzed by dual lumen dialysis catheter. If we measure the recirculation in these patients and find significant, we can improve the dialysis efficiency by modifying the dialysis prescription or eliminating

recirculation by changing access. Therefore, this study is planed to measure recirculation in these patients.

MATERIAL AND METHODS

The present study was done in a tertiary care hospital based dialysis department and a free standing dialysis center of Shaikh zayed hospital Lahore and Quaid-i-Azam medical college Bahawal pur, in which collectively approximately 135 hemodialysis patients are treated daily. All patients requiring temporary venous catheters for vascular access for intermittent hemodialysis during a certain 8 months period were included. Informed consent was obtained from all participating patients. A total of 125 patients dialysed through double lumen catheter were enrolled for the study. The patients with graft or AV fistula thrombosis need for dialysis before the AV fistula matured, or the need for acute dialysis without other means of vascular access were included. Catheters placed for plasmapheresis or for dialysis treatment in the ICU or patients having functioning arteriovenous fistula were excluded.

A brief history and clinical examination was done of each patient. Age, sex, site of central access, type and cause of renal failure was especially recorded. Then all patients were dialysed through two lumen large bore straight catheter (12FR x 16 Cm) on Hemodialysis machines of FMC 4008 S (Fresenius Medical Care AG, Bad Homberg, Germany. The standard dialysis prescription was used in all patients. The low blood flow sampling protocol for accurate urea-based measurement of recirculation was used. Which is the test was performed after approximately 30 minutes of initiation of dialysis and turning off ultra filtration. Arterial (A) and venous(V) line samples was drawn. Immediately Access blood flow rate was reduced to 50m/minute. Then blood pump was off exactly 10 sec after reducing blood flow. Arterial line was clamped immediately above sampling port. Systemic arterial sample(S) from arterial line port was drawn with in 30 seconds. Line was unclamped and dialysis was resumed. Blood was analyzed by the hospital laboratory using standard procedures. Then percentage (%) recirculation was calculated from following formula1; Percentage Recirculation= S-A/S-V x 100.

Systemic (S) – Arterial (A)/ systemic – Venous (V) x 100

Analysis was done by using computer software SPSS10 [Statistical Package for Social Sciences]. The sociodemographic profile like sex, type of renal failure and site of venous catheter etc is given in percentages by simple descriptive statistics. All the numerical variables like age and percentage recirculation is presented as mean and standard deviation. Percentage recirculation between internal juglar and subclavin catheterization is compared with unpaired t-test and p value £ 0.05 is taken as significant.

RESULTS

Out of 125 patients 53 (42.4%) were males, whereas 72(57.6%) were females. Their mean age was 43.4 ± 15.7 years. Hemodialysis was done through right internal jugular access in 60 patients while 60 were dialyzed through right subclavian line and five from right femoral vein. Renal failure was acute in 34 patients while remaining 91 patients were of end stage renal disease that was waiting for the creation or maturation of their permanent access for dialysis. The two major causes of acute renal failure were sepsis and postpartum hemorrhage and in case of end stage renal disease the two major causes were diabetic nephropathy and chronic glomerulonephritis(Table 1). The percentage recirculation was 10.3± 6.4 with range from 3.6 to 24.8 (Table 2). The comparative values with their significant level in different subgroups are given in table 3. There is no significant different in recirculation with regard to site of double lumen Catheter with constant catheter length (p-value 0.211), type of renal failure (p-value 0.76) and sex (p-value 0.34) while when these catheter were used in femoral veins they gave higher percentage recirculation of 15.2 ± 4.6 as the length of catheter was small (p-value 0.002).

DISCUSSION

According to National Kidney Foundation DOQI guidelines any access recirculation is abnormal. Recirculation exceeding 10% using the recommended two-needle urea-based method, or 5% using a nonurea-based dilutional method, should prompt investigation of its cause[11]. In this study mean recirculation by two needle

Table-I. Base Line Characteristics of study population

Variable	Value
Age (mean±SD)	**43.4±15.7**
Male	42.4
Female	57.6
Etiology of ESRD* (%) n=91	
Diabetes mellitus	35
Hypertension	29
Glomerulonephritis	27
Others	09
Etiology of acute renal failure (%) n=34	
Postpartum	50
Sepsis	27
Trauma	13
Others	10

**End Stage Renal Disease*

Table-II. Percentage Recirculation

Number of patients	Percentage recirculation (range)
04	1-5
47	5.1-10
39	10.1-15
23	15-20
12	>20

Table-III. Comparison of Recirculation among subgroups with urea based method.(n=125)

	Mean±SD	p-value
Right subclavian access (n=60)	11.25±6.5	.211
Right juglar access (n=60)	9.15±4.4	
Acute renal failure (n=34)	10.35±6.9	0.764
Chronic renal failure (n=91)	10.32±6.2	
Male (n=53)	9.45±4.6	.399
Female (n=72)	11.13±6.5	

urea based method is 10.6± 5.9 which is almost at the upper limit of the values recommended by the DOQI guidelines. Many factors affect the rate of recirculation in central venous catheter. Of particular note is the impact of line reversal which has consistently been shown to raise the recirculation rate in some cases near to 8% to 18%.Many multivariate analysis have shown that catheter location and length are independent predictors of recirculation but many of them have compared recirculation between jugular and femoral route in which catheters length was definitely different and also different methods of recirculation were used like ultrasonic dilution method[12,13]. Blood flow, duration into dialysis, time since catheter insertion, cardiac rhythm, and catheter type had no significant effect on recirculation rates as studied by many authors[14,15].The few studies have objected that The three-needle peripheral vein method of measuring recirculation should not be used as this method overestimates access recirculation in an unpredictable manner and requires unnecessary venipuncture. These studies have recommended that three sample methods for detecting recirculation should not be preffered[16], where dilutional based methods are available. One study has reported recirculation by two-needle technique averaged 15.2% which is higher and this study has described that the technique was insufficiently sensitive to be of value in clinical practice[17]. Apart from other drawbacks of two needle urea based method, it also requires accurate timing of blood samples during the early period of most rapid urea rebound, which may be difficult to achieve in a busy renal unit. But still this method is most commonly used[18,19].

Evidence now indicates that in well canulated arteiovenous access recirculation occurs only when the rate of access blood flow decreases to that of dialyzer blood flow or blood pump speed. One common cause for this situation is venous stenosis. However recirculation does occur through central venous catheter, a some what surprising finding given that blood flow rate in superior vena cava approach 2L/min. One possible explanation for recirculation in central venous catheter may be the close proximity of inflow and outflow limb of the catheter[20,21]. In one metaanalysis,it has been hypothesized that recirculation may be due to the intermittent nature of blood flow in superior vena cava through out cardiac cycle. Twelve studies have summarized that recirculation rate in central venous catheter range 1.7% to 11.9%[8,22,23]. Access recirculation in

double lumen catheter also depends upon the length of catheter and site[24]. One study which have measured the urea recirculation and dialysis efficiency by using double lumen catheters in various locations, have reported the recirculation rates of 4%, 5% and 10% for internal jugular, subclavian and femoral catheter respectively[10,25]. Although there is higher recirculation in subclavin access than jugular in this study but difference is statistically insignificant. This higher tendency of recirculation in subclavin route is unexplainable as the length of catheter and blood flow rate was constant.

CONCLUSIONS

Our results have shown the upper limit of acceptable recirculation (10.3± 6.6) through double lumen catheter. Central venous catheter remains an important temporary access and in some cases the only achievable access for the patients. When recirculation is high, one should check for reversal of lines and should modify dialysis prescription to achieve prescribed adequacy level in these patients.

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Article received on: 10/01/2011 Accepted for Publication: 05/06/2011 Received after proof reading: 00/00/0000

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Article Citation:
Akram M, Abbas G. Recirculation in double lumen catheters in patients undergoing hemodialysis. Professional Med J Sep 2011;18(3): 470-474.

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(Ayn Rand 1905-1982)