

Anaemia in Renal Failure Patients Undergoing Dialysis: Are Blood Losses from Repeated Femoral Cannulation Significant?

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ABSTRACT

Anaemia is one of the major complications of renal failure with significant effects on the quality of life, morbidity and mortality of patients with renal failure. The aetiology of anaemia in renal failure is generally thought to result from inadequate erythropoietin production, reduced life span of erythrocytes in uraemic serum and bone marrow suppression by yet unidentified uraemic toxins. The role of blood losses from access route cannulation has however not been adequately evaluated. The aim of this study was to evaluate the amount of blood loss during repeated femoral cannulations and correlate this with haematocrit changes in our dialysis population. One hundred and forty two dialyzed patients (87 males and 55 females with a mean age of 40.7 ± 15.6 yrs [SD]) who had repeated femoral cannulations as their access route were studied during their first 5 haemodialysis sessions. Volume of blood loss during each femoral cannulation procedure was derived by comparing the weight of blood in soaked gauze and drape used for cannulation with the weight of 10mls of the patient's blood during the same procedure. Their haematocrit at the end of the salvage dialysis was compared with the expected PCV values from the blood transfusion details, to evaluate the effect of repeated blood losses during access route cannulation.

Mean blood loss during cannulation was $36.52\text{mls} \pm 2.70$ SD. Range 6.47mls – 100.20 mls. Mean PCV at onset of dialysis was 20.54 ± 6.5 % compared with 18.36 ± 4.8 % at the end of the salvage session. When compared with the expected mean of $23.29\% \pm 5.45$ SD derived from the transfusion details of the patients, the results were statistically significant $t=4.6$, $p < 0.05$. There was also a positive correlation between blood loss and PCV changes, however this did not reach a statistically significant level ($r = +0.63$, $p > 0.05$).

It was concluded that repeated femoral cannulation could be a clinically important cause of blood loss and failure of haematocrit response to multiple blood transfusions, in haemodialysis patients. It is hoped that this finding would encourage dialysis units to review their policies on access route practices for dialysis.

INTRODUCTION

Anaemia in patients with renal failure is increasingly becoming recognized as an important complication with a very significant influence on their quality of life, morbidity, and mortality. Aetiologically, anaemia in renal failure is thought to result from inadequate erythropoietin production, reduced life span of erythrocytes in uraemic serum and bone marrow suppression by yet unidentified uraemic toxins [1, 2, 3, 4]. Recently, pure red cell aplasia from erythropoietin administration has constituted a cause for concern in patients with chronic renal failure (CRF) on erythropoietin therapy [5, 6]. The contributions of blood losses from vascular access route cannulation have not been adequately studied.

Repeated femoral vein cannulation is the most frequently used route for vascular access for haemodialysis in Nigeria. Blood losses from this access route may be a significant factor for sustenance of anaemia, or poor response to erythropoietin therapy in our dialysis patients. Our observation that multiple blood transfusions tend not to adequately correct anaemia in haemodialysis patients on repeated femoral vein cannulation in our centre and many others, prompted us to evaluate this factor as a cause of anaemia in this group of patients.

AIM

The aim of this study was to determine the effect of repeated femoral vein cannulation on patient's

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heamatoctrit levels during the “salvage dialysis” period.

PATIENTS AND METHODS

All patients dialyzed using repeated femoral cannulation between 1st of January 2004 to 31st of December 2004 were included in the study.

Quantification of blood loss during cannulation

Blood loss during cannulation was quantified as follows: - Sterile drape and pre – packed gauze (10 pieces per pack) were weighed on a sensitive laboratory scale separately, before the procedure. The weights were recorded (D_0 and G_0).

Femoral cannulation procedure was then carried out ensuring that all blood lost during the procedure was absorbed with the gauze and drape. Used pieces of gauze and the remaining unused ones in the pack were weighed and the weight noted (G_B). The weight of used drape was obtained separately (D_B). Weight of blood loss (W_{BL}) during cannulation was then obtained using the following equation:

$$W_{BL} = [G_B + D_B] - [G_0 + D_0] \dots\dots\dots \text{Equation 1}$$

A new 10ml syringe was weighed (S_0). 10mls of blood was withdrawn from the patient using the 10ml syringe; this was quickly weighed (S_B) and the blood re – infused back to the patient. The femoral catheter was thereafter flushed with saline.

Weight of 10mls of patient’s blood (W_{10}) was obtained using the following equation:

$$W_{10} = S_B - S_0 \dots\dots\dots \text{Equation 2}$$

Volume of blood loss (V) was calculated using the following equation:

$$V = (10 * W_{BL}) / W_{10} \dots\dots\dots \text{Equation 3}$$

Evaluation of changes in haematocrit levels

Haematocrit changes and blood transfusion requirements were analyzed during the first 5 dialysis sessions. Data on their Packed cell volume (PCV) at presentation, pre-dialysis PCVs during the first 5 dialysis sessions, number of blood transfusions, and documented evidence of blood loss from other sites were obtained from their case notes and haemodialysis record charts.

In patients who received blood transfusion, the observed PCV values were compared with the expected 3% PCV rise per pint of blood transfused.

In those patients who did not receive blood transfusion, the expected PCV was taken as the PCV at presentation, as this is not expected to change significantly during the first 2 weeks of treatment in the patients.

Statistical analysis

Student’s t – test statistics was used to compare the differences between groups. Correlation of blood loss during cannulation with changes in heamatoctrit values obtained was done using Pearson’s correlation coefficient. P value of <0.05 was taken as significant.

RESULTS

A total of 142 patients were dialyzed in 343 “salvage dialysis” sessions, using repeated femoral cannulations between 1st January 2004 and 31st December 2004 in our Centre. There were 87 males and 55 females (M: F ratio 1.5:1). [Table 1]. 80 (56.3%) patients had chronic renal failure, while 44 (31%) had acute renal failure. The remaining 18 (12.7%) patients came in with an acute on chronic renal failure.

Mean urea level 198.57mg/dl ± 11.88mg/dl SD, mean creatinine level was 11.08mg/dl ± 1.25mg/dl SD.

The mean PCV at presentation was 20.54% ± 6.5 SD. There was a progressive reduction in PCV values over the first 5 sessions of haemodialysis. Mean PCV after the 5th haemodialysis session was 18.34% ± 4.8 SD.

Expected mean PCV value (estimated from the transfusion details of the patients) after the 5th haemodialysis session was 24.32% ± 5.45%. There is a statistically significant difference when compared with the observed mean PCV value at the end of the fifth dialysis session. t = 4.6 p < 0.05 [Table 2].

Adequate recovery of blood loss by gauze and drape was obtained in 142 of the 343 sessions. In the remaining sessions, incomplete collection of soaked gauze or significant soaking of bed linen and patients’ gown militated against accurate estimation of the volume of blood lost in those sessions.

Mean blood loss during cannulation was 36.52mls ± 2.70 SD. Range 6.47mls – 100.20mls. A positive correlation was obtained between the volume of blood loss during cannulation and the degree of decline in patients PCV before the next dialysis session r = +0.63, p>0.05

A total of 69 patients received at least 1 pint of blood during the salvage dialysis session while 72 patients did not receive blood transfusion. 105

30.61%) pints of blood were transfused intra-dialysis in 343 dialysis sessions in which repeated femoral vein cannulation was employed as access route [Table 1].

Table 1: Showing age/sex distribution of patients dialyzed

	0-19	20-39	40-59	>60	Unrecorded	Total
M	2	29	33	10	4	87
F	6	38	12	7	1	55
Total	8	67	45	17	5	142
<i>Mean age was 40.7yrs ± 15.6 SD, range 10yrs – 85yrs.</i>						
Mean PCV (SD)	20.54 (6.5)	18.8 (5.16)	18.34 (5.5)	19.14 (6.2)	18.36 (4.8)	
Expected	20.54 (6.5)	21.59 (6.4)	22.26 (4.2)	22.92 (5.3)	23.29 (5.45)	
Mode PCV	19	15	15	15	15	18
Range	7-47	10-39	6-34	9-39	8	
-30	t = 4.6	p < 0.05				
Total dialyzed		142	73	59	39	30
Untransfused patients		98	54	43	33	23
1 pint of blood		40	15	12	5	7
2 pints of blood		4	4	4	1	0
Total No. of blood transfused	48	23	20	7	7	

A total no of 105 pints of blood was transfused in 343 dialysis sessions (30.61%)

DISCUSSION

Anaemia is an almost invariable consequence of chronic renal failure. As renal function deteriorates, there is a slow, progressive decrease in haemoglobin concentration that becomes particularly evident once the glomerular filtration rate (GFR) declines below 30 ml/minute. Aetiological considerations have focused predominantly on inadequate erythropoietin production, reduced life span of erythrocytes in anaemic serum and bone marrow suppression by yet unidentified uraemic toxins.[1, 2, 3, 7]. Evidences are however accruing on the important contributory roles of other aetiological factors such as pure red blood cell aplasia [5, 6], chronic inflammation [8, 9] and cardio-renal anaemia syndrome [10].

Clinically significant haemolysis can occur as a result of the dialysis procedure [11]. Contamination of dialysis fluid with hydrogen peroxide, and inadequate removal of copper, zinc, nitrates and chloramines by the water treatment process are known causes of intradialysis haemolysis [12, 13]. In addition, recurrent blood losses during access route cannulation occur frequently. However, the role of blood losses from this procedure in the sustenance and aggravation of anaemia in renal failure patients have not been fully clarified. Our study focuses on the possible contribution of blood losses from repeated femoral cannulation in the sustenance of anaemia in renal failure patients undergoing dialysis therapy. The study is relevant in view of the fact that femoral vein cannulation is the most widely used access for haemodialysis in Nigeria.

The mean PCV of the studied patients at presentation was $20.54\% \pm 6.5$ SD. indicating the presence of severe anaemia in the patients at presentation. This is much lower than what is observed in more advanced countries [14]. The reasons for this finding of very low PCV at presentation are likely to be multifactorial. They may include late presentation of the patients to the hospital, late referral to the nephrology unit and inadequate pre – ESRD care of anaemia in those patients with ESRD. Only two of the CRF patients in our study population were on erythropoietin therapy prior to commencement of dialysis.

The mean estimated blood loss during each femoral cannulation in our study subjects was $36.52\text{mls} \pm 2.70$ SD. This value underestimates the true average blood loss during routine procedures, as cannulation events with more severe bleeding were excluded from our analysis. This is due to inadequacy of sample collection in these instances, as a result of incomplete collection of soaked gauze or significant soaking of bed linen and patients' gown during cannulation. However, this figure sheds some light to the possible contributory role of repeated femoral vein cannulation in the sustenance of anaemia in these patients, as the average blood loss during five dialysis sessions was 182.6mls. The loss of close to 200mls of blood by severely anaemic subjects in a period of less than two weeks intuitively depicts a clinically important contributory role of repeated femoral cannulation in the sustenance of anaemia in the patients.

A positive correlation was obtained between the volume of blood loss during cannulation and the degree of decline in PCV before the next dialysis session ($r = +0.63$, $p > 0.05$). However, this was not statistically significant. Possible explanation for this observation may be due to the operational contribution of other factors such as losses into bloodlines, dialyzers and also, on going intravascular haemolysis in some of the patients. Our study did not evaluate these factors. Future studies designed to evaluate these factors are needed, as these would definitely enhance our knowledge on the significance of each of these factors in the sustenance of anaemia in renal failure.

There was a progressive reduction in PCV values over the first 5 sessions of haemodialysis from a mean PCV value of $20.54\% \pm 6.5$ SD at presentation to a mean PCV value of $18.34\% \pm 4.8$ SD after the 5th haemodialysis session. The clinical relevance of this decline becomes more obvious if this value is compared with the expected PCV of $24.32\% \pm 5.45\%$

estimated from the transfusion details of the patients [Table 2]. This decline occurred over a period less than 2 weeks pointing to the presence of an active and significant cause of blood loss from the patients' circulation. Identification and correction of these factors would definitely improve patients' outcome, in addition to a considerable reduction in the cost of treatment of anaemia related complications in renal failure. [15, 16]. The fact that gradual improvement in haematocrit values over time is seen in the majority of patients treated in centers where central venous catheterization and early creation of arterio-venous fistulas are used more frequently, suggests that blood losses from routine cannulation of these vascular routes may be comparatively lower than that seen in repeated femoral cannulation. A comparative analysis of the volume of blood loss during cannulation of the various access routes is thus desirable, to shed more light on this issue.

One hundred and five pints of blood were transfused in 343 dialysis sessions [30.61%] Table 3. This high rate of blood transfusion in the patients exposes them greatly to the complications of blood transfusion [17, 18, 19, 20]. Secondly, there is a serious concern about the exposure of the patients to a wide range of HLA antigens with a consequent sensitization to these antigens. This increases the probability of early graft rejection and graft failure in the patients who would eventually opt for kidney transplantation [21, 22]. This could be prevented if blood losses from access route cannulation and other operational factors causing rapid reductions in patients' haematocrit levels are minimized.

Our study has demonstrated a possible contributory role of blood losses during repeated femoral cannulation to the sustenance of anaemia in dialysis patients. Considering the fact that repeated femoral cannulation is the predominant method of vascular access for haemodialysis in the majority of our dialysis unit in this country, the magnitude and clinical significance of this finding becomes apparent as more than 95 percent of our dialysis patients are subjected to this procedure routinely. More frequent use of other means of vascular access for haemodialysis may presumably lead to reduction of blood loss in our patients and impact significantly on our efforts to reduce the severity of anaemia in these patients.

In conclusion, anaemia is very prevalent in our dialysis population. Repeated femoral cannulation may contribute to the generally observed progressive worsening of anaemia in our dialysis patients. We therefore recommend preferential placement of

central venous catheters at the commencement of dialysis in practically all patients requiring dialysis, instead of repeated femoral vein cannulation. Early arterio-venous fistula creation in the patients on chronic maintenance dialysis is also a desirable clinical goal to minimize blood losses during vascular access cannulation for haemodialysis.

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