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ORIGINAL ARTICLE

Anemia Profile in Conventional Versus Incremental Hemodialysis Patients

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Abstract

Background: **Hemodialysis (HD) is performed to purify the blood by using diffusion to facilitate solute exchange and water removal over a semipermeable membrane. Using a patient's renal kidney function as a guide, incremental HD tailors HD to each person's specific needs.**

Aim and objectives: **To compare the effects of incremental HD and standard HD on anemia profile in individuals with end-stage kidney disease.**

Patients and methods: **Individuals with end-stage renal illness (aged and sexed similarly) participated in this prospective cohort observational research. The research took place over the course of 6 months at Syd Jalal University Hospital's Nephrology Unit, and involved 50 individuals split evenly between two groups.**

Results: **There was no indication of a statistically significant variance among the groups in the research investigations as regard age, sex, weight, EPO and iron treatment, baseline, 1, 2, and 3 months kt/V, baseline hemoglobin, 1, 2, and 3 months hemoglobin, baseline TAST, 1, 2, 3, and 4 months TAST, Na and K. The statistical significance level was quite high ($P < 0.001$) increased dialysis vintage, reduced 4 and 5 months kt/V in group I when contrasted with group II.**

Conclusion: **Incremental HD exerts a better job in maintaining the residual kidney function, hence improving the anemia profile and response to ESA therapy. By improving the anemia profile we decrease both morbidity and mortality among dialysis patients, also improving the quality of life and exercise tolerance and decreasing cardiovascular complications.**

Keywords: Anemia profile, Conventional, Hemodialysis, Incremental

1. Introduction

End-stage renal disease (ESRD) is referred to as kidney deterioration for more than or equal 3 months due to defects in kidney structure or function and glomerular filtration rate (GFR) less than 15 ml/min.[1]

When treating uremia, dialysis or a transplanted kidney is used to replenish the body's fluid and electrolyte stores. Hemodialysis (HD) is a method of blood purification that employs diffusion to facilitate solute exchange and water removal over a semipermeable membrane. Diffusion is a process by which molecules flow randomly over a semipermeable barrier, causing a net movement of solutes from regions of high concentration to those of low concentration.[2]

Typical HD treatment plans for new cases typically involve three HD treatments per week lasting 3–4 h each, with limited customization depending on residual kidney function (RKF) or other cases characteristics.[2]

Surprisingly, the three-HD-sessions-per-week plan has been generally recognized across the world without ever being put through a randomized controlled study to see if it is sufficient or detrimental to treat HD less often.[2]

Incremental HD, which tailors HD treatment to each patient based on their renal kidney function, has gained popularity recently since it allows dialysis to be initiated with less intensity than traditional methods. In incremental HD, the dosage of dialysis is adjusted based on a combination of the

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patient's RKF and their dialysis clearance. Standard Kt/V (Std Kt/V) is one such approach that can help, as it takes into account both the contributions of the standard Kt/V RKF and the standard Kt/V dialysis.[3]

In individuals undergoing maintenance HD, anemia is a frequent complication that can have a significant effect on quality of life. Anemia has been linked to raised risk of hypotension, heart failure, hospitalization, and death,[4] which we are going to investigate its relationship with another highly important issue which is renal anemia.[5]

This research set out to assess influence of incremental HD versus conventional HD on anemia profile among cases with end-stage kidney illness.

2. Patients and methods

Individuals suffering ESRD (who were matched for age and sex) participated in this prospective observational cohort research. The research was carried out at the Nephrology Unit at Syd Jalal University Hospital over the course of 6 months, with a total of 50 cases split evenly between two groups, group I: 25 patients. Incremental HD (twice session per week) and group II: 25 patients. Conventional HD (three session per week).

2.1. Inclusion criteria

Individuals who are 18 and above, in stable health, who have been on dialysis for more than 3 months, and who have an arterio-venous fistula and RKF permits twice weekly dialysis.

2.2. Exclusion criteria

Age less than 18 years, patients who were using dialysis catheter, patients with hepatic impairment or infectious disorders, along with those with malignant conditions in roughly a month of instances.

At enrollment, all patients will be subjected to the following: full history, comprehensive clinical examination, baseline laboratory workup, changes in complete blood count, iron profile, standard Kt/V, all patients used heparin anticoagulants and standard dialysis fluids, RKF and usage and amount of ESA and iron.

2.3. Ethics and patient consent

The standards established through the ethics council of Al-Azhar University were adhered to during all operations, and patients provided their written agreement.

2.4. Statistical analysis

SPSS, version 24 was utilized to analyze the data. Percentages and frequencies were utilized to represent qualitative data. If the numbers were normally distributed, they were written as mean SD, and if they were not, they were written as median [interquartile range (IQR)].

The following tests were done: independent sample t test, Mann–Whitney U test, χ^2 test and P value.

3. Results

Table 1 showed that no statistically significant variations were observed among the groups as regard age ($P = 0.192$), sex ($P = 0.571$), and weight ($P = 0.150$). Highly statistical significant ($P < 0.001$) increased dialysis vintage in group I (median = 24, IQR = 12.5–61.5) when compared with group II (median = 11, IQR = 8.5–15.5).

Table 2 showed that there was no statistical significant difference between studied groups as regard EPO treatment ($P = 0.254$) and iron treatment ($P = 0.777$).

Table 1. Comparison of demographic data between studied groups.

	Group I ($N = 25$)	Group II ($N = 25$)	Statistical test	P value
Age (years)				
Mean ± SD	49.8 ± 15.5	55.6 ± 15.7	$t = 1.32$	0.192 NS
Sex [n (%)]				
Male	12 (48)	14 (56)	$\chi^2 = 0.32$	0.571 NS
Female	13 (52)	11 (44)		
Dialysis vintage				
Median	24	11	MW = 127	<0.001 HS
Interquartile range	12.5–61.5	8.5–15.5		
Weight (kg)				
Mean ± SD	72.6 ± 14.1	78.3 ± 13.5	$t = 1.46$	0.150 NS

MW, Mann–Whitney U test.
t, independent sample t test. HS: P value less than 0.001 is considered highly significant.
χ^2, χ^2 test. NS: P value more than 0.05 is considered nonsignificant.

Table 2. Comparison between studied groups as regard EPO and iron treatment.

	Group I ($N = 25$)	Group II ($N = 25$)	Statistical test	P value
EPO treatment [n (%)]				
No	9 (36)	13 (52)	$\chi^2 = 1.29$	0.254 NS
Yes	16 (64)	12 (48)		
Iron treatment [n (%)]				
No	13 (52)	12 (48)	$\chi^2 = 0.08$	0.777 NS
Yes	12 (48)	13 (52)		

Table 3 exhibited no statistically significant variations among the groups under study as regard baseline Kt/V ($P = 0.463$), 1 month kt/V ($P = 0.887$), and 2 months kt/V ($P = 0.580$). And, statistically significant ($P = 0.015$) decreased 3 months kt/V in group I (0.97 ± 0.12) when contrasted with group II (1.05 ± 0.12). The statistical significance level was quite high ($P < 0.001$) reduced 4 months kt/V in group I (0.94 ± 0.10) when contrasted with group II (1.08 ± 0.09), and 5 months kt/V in group I (0.93 ± 0.11) when compared with group II (1.12 ± 0.10).

Table 4 exhibited no statistically significant variations among the groups under study as regard baseline Hb ($P = 0.332$), 1 month Hb ($P = 0.834$), 2 months Hb ($P = 0.635$), and 3 months Hb. And, there was statistically significant ($P = 0.015$) decreased 4 months Hb in group I (9.6 ± 1.20) when compared with group II (10.3 ± 0.73) and statistically significant ($P = 0.001$) decreased 5 months Hb in group I (9.6 ± 1.14) when contrasted with group II (10.6 ± 0.83).

Table 5 showed that No statistically significant variations were observed among the groups as regard baseline TAST ($P = 0.478$), 1 month TAST ($P = 0.6$), 2 months TAST ($P = 0.606$), 3 months TAST ($P = 0.484$), and 4 months TAST. There was a statistically significant ($P = 0.039$) reduced 5 months

Table 3. Comparison of Kt/V between studied groups.

	Group I ($N = 25$)	Group II ($N = 25$)	t	P value
Kt/V (baseline)				
Mean ± SD	0.99 ± 0.13	0.96 ± 0.15	0.74	0.463 NS
Kt/V (1 month)				
Mean ± SD	0.98 ± 0.12	0.98 ± 0.13	0.14	0.887 NS
Kt/V (2 months)				
Mean ± SD	0.98 ± 0.12	1.00 ± 0.13	−0.55	0.580 NS
Kt/V (3 months)				
Mean ± SD	0.97 ± 0.12	1.05 ± 0.12	−2.5	0.015 S
Kt/V (4 months)				
Mean ± SD	0.94 ± 0.10	1.08 ± 0.09	−4.8	<0.001 HS
Kt/V (5 months)				
Mean ± SD	0.93 ± 0.11	1.12 ± 0.10	−6.4	<0.001 HS

S: P value less than 0.05 is considered significant.

Table 4. Comparison of hemoglobin between studied groups.

	Group I ($N = 25$)	Group II ($N = 25$)	t	P value
Hb (baseline)				
Mean ± SD	10.0 ± 1.25	9.7 ± 1.03	0.98	0.332 NS
Hb (1 month)				
Mean ± SD	9.9 ± 1.28	9.8 ± 0.97	0.21	0.834 NS
Hb (2 months)				
Mean ± SD	9.8 ± 1.30	9.9 ± 0.91	−0.47	0.635 NS
Hb (3 months)				
Mean ± SD	9.7 ± 1.32	10.2 ± 0.82	−1.45	0.151 NS
Hb (4 months)				
Mean ± SD	9.6 ± 1.20	10.3 ± 0.73	−2.5	0.015 S
Hb (5 months)				
Mean ± SD	9.6 ± 1.14	10.6 ± 0.83	−3.4	0.001 S

Hb, hemoglobin.

Table 5. Comparison of TAST between studied groups.

	Group I ($N = 25$)	Group II ($N = 25$)	MW	P value
TAST (baseline)				
Median	33	26	276	0.478 NS
Interquartile range	18.5–40	15.5–41		
TAST (1 month)				
Median	28	26	285.5	0.6 NS
Interquartile range	19–40	17–41		
TAST (2 months)				
Median	30	29	286	0.606 NS
Interquartile range	20–39	20–41.5		
TAST (3 months)				
Median	35	30	276.5	0.484 NS
Interquartile range	20.5–37	22–40.5		
TAST (4 months)				
Median	32	30	246	0.196 NS
Interquartile range	23–35.5	25.5–40.5		
TAST (5 months)				
Median	30	31	206.5	0.039 S
Interquartile range	24–35.5	28.5–40.5		

TAST in group I (median = 30, IQR = 24–35.5) when compared with group II (median = 31, IQR = 28.5–40.5).

Table 6 exhibited that there was no statistical significant variance among studied groups as regard Na ($P = 0.966$) and K ($P = 0.313$). There was a statistically significant ($P = 0.002$) increased C-reactive protein (CRP) in group I (median = 8, IQR = 6–10) when compared with group II (median = 5, IQR = 4–6.5), statistically significant ($P = 0.006$) decreased ALB in group I (3.88 ± 0.56) when contrasted with group II (4.4 ± 0.61), and statistically significant ($P = 0.045$) raised iPTH in group I (median = 316, IQR = 214.5–464) when compared with group II (median = 265, IQR = 200–333.5).

4. Discussion

According to data gathered from a cohort research conducted by Zhang and colleagues, 168 ESRD patients were assessed and separated into two groups according on the initial 6-month HD frequency: 58 individuals made up group A; they all started on a twice-weekly HD schedule and stayed with it for at least 6 months without changing to a thrice-weekly one. One hundred and ten people with HD comprised group B, and they all began therapy on a thrice-weekly schedule and stuck with it until the conclusion of the cohort.[6]

No statistically significant difference in hemoglobin levels was seen among the two groups in this section of the trial, showing that two times per week therapy can provide equivalent HD adequacy as weekly treatment.

Our research found that the twice-weekly regimen was more protective than the three times per week regimen, in continuation with hemoglobin levels showing no significant variations among the groups from baseline to the fourth month but showing a significant difference at 5 and 6 months.

Table 6. Comparison of other studied laboratory data between studied groups.

	Group I ($N = 25$)	Group II ($N = 25$)	Test	P value
Na (mmol/l)				
Mean ± SD	138.9 ± 3.3	138.9 ± 3.2	$t = 0.043$	0.966 NS
K (mmol/l)				
Mean ± SD	5.0 ± 0.63	4.8 ± 0.57	$t = 1.02$	0.313 NS
C-reactive protein (mg/l)				
Median	8	5	MW = 151.5	0.002 S
Interquartile range	6–10	4–6.5		
ALB (g/dl)				
Mean ± SD	3.88 ± 0.56	4.4 ± 0.61	$t = 2.8$	0.006 S
iPTH				
Median	316	265	MW = 209	0.045 S
Interquartile range	214.5–464	200–333.5		

MW, Mann–Whitney *U* test.

Nonetheless, Obi and colleagues found an important variation that held up throughout subsequent quarters and across all correction models. Dialysis was done less often and for shorter periods of time in patients on the incremental regimen, and they had lower baseline levels of hemoglobin concentrations as well as serum adjusted calcium and greater serum ferritin concentrations.[7]

Each visit indicated a highly significant variance when the Kt/V Daugirdas calculator was used to assess dialysis adequacy in the incremental group, just as it did in the traditional group. There were also statistically significant changes among both groups over time, with the incremental arm consistently coming out on top.

Individuals with RKF on two times per week HD had a substantially greater dialysis adequacy than individuals with or without RKF on thrice-weekly HD, as measured by renal Kt/V at all follow-up periods in the research by Hwang and colleagues. These results imply that if RKF is properly conserved, a dialysis dosage of twice weekly HD therapy may be achieved, equivalent to that of three times per week HD therapy. This also matched up with the results of our research.[8]

There were no statistically significant differences between the incremental and conventional groups at any time during the study period when comparing blood calcium levels between the two groups. There were also no discernible variations among two groups during the course of the follow-ups.

As regarding CRP there was statistically significant increased CRP in group I when contrasted with group II.

CRP and interleukin-6 (IL6) are two of the serum inflammatory biomarkers that have been reported to be significantly elevated in 30–50% of CKD patients.[9] In this instance, inflammation can have a variety of causes, some of which are related to the cases (such as underlying disease, comorbidities, oxidative stress, infections, obesity, genetic or immunologic factors), and others to HD itself (primarily dialysis membrane biocompatibility and dialysate quality).[10]

In tandem with the survival response, the erythropoietic drive mobilizes its arsenal to counteract the downregulation of iron absorption caused by hepcidin. This is done by inhibiting both the inflammatory and iron-sensing pathways.[11]

Cytokines including ILI1 IL6, IL10, interferon ɣ, and tumor necrosis factor-α are produced by the immune system in response to the systemic inflammation triggered by dialysis problems. Iron limitation, inhibition of EPO synthesis, and a reduction in the lifespan of erythroid progenitors all contribute to the development of iron-deficiency anemia.[12]

Our research shows that the conventional group saw a statistically significant rise in parathormone compared to the incremental group.

If the GFR falls below 60 ml/min/1.73 m^2, a rise in PTH levels is common. In patients with CKD, abnormalities in blood phosphorus and calcium levels normally do not show up until late in the disease process (usually when the GFR goes below 40 ml/min/1.73 m^2).[13]

Increased renal phosphorus excretion is a short-term effect of high PTH levels. Serum phosphorus levels begin to rise when GFR decreases, inducing hypocalcemia by the binding of bioavailable calcium as $CaHPO_4$. This, in turn, leads to an increase in PTH synthesis. In addition, CKD lowers 1-α-hydroxylase activity, which lowers 1,25-OH vitamin D levels. Inadequate levels of 1,25-OH vitamin D prevent calcium from being absorbed in the gut and indirectly activate the parathyroid glands.[14]

Erythropoietin production drops drastically when serum iPTH levels rise. Numerous studies have shown that parathyroidectomy decreases the need for EPO in individuals with ESRD, proving the validity of this idea.[15]

4.1. Conclusion

In conclusion, incremental HD exerts a better job in maintaining the RKF, hence improving the anemia profile and response to ESA therapy. By improving the anemia profile, we decrease both morbidity and mortality among dialysis patients, also improving the quality of life and exercise tolerance and decreasing cardiovascular complications.

Conflicts of interest

There are no conflicts of interest.

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