Treatment factors and interventions that may influence outcome of chronic Hemodialysis in children, A multicenter study: (Cross-section study)

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Abstract

**Background**: as the prevalence of children on renal replacement therapy (RRT) increases worldwide and comprises at least 2% of any national dialysis or transplant programme, it is essential that paediatric nephrologists are able to advice families on the possible outcome for their child with end-stage renal disease. Most children start hemodialysis with the expectation that a successful renal transplant is an achievable goal and will provide the best survival and quality of life. However, some will require long-term dialysis or may return intermittently to dialysis the course of their chronic kidney disease. Pediatric dialysis carries a significantly higher mortality than that for the age-adjusted population.

**Objectives**: To know the 4 years outcome of pediatric patients on chronic hemodialysis program, and some treatment factors and interventions that may affect the outcome.

**Patients and Methods**:
A cross-sectional study of all chronic hemodialysis patients who started dialysis in pediatric age, in hemodialysis centers in Al Kharkh side of Baghdad city extended between the 1st of January of 2011 to 31th of December 2014. During which 94 patients were collected. Clinical and laboratory data were obtained from medical records and by direct interview with each patient by questionnaire. The questionnaire include variables in the patients' treatment factors that may influence outcome. Data was observed and analysis was carried out using spss-21.

**Result**: During the period of the study, a total of 94 patients on chronic HD program were studied according to patients' demographics data, where the age group ≤ 7 years were (26.6%) while these ≥ 14 years were (7.44%). Male form (63.82%) while female (36.17%). (75.5%) of patients were from Baghdad city. According to patients type of vascular access, CVC was (71.27%) and (28.72%) for AVF. (43.61%) of patient receive their HD twice weekly (56.38%) thrice weekly. Time of hemodialysis sessions was 3 hour per session in (61.7%) and 4 hr / session (38.2%). (52.12%) of our patients spent ≤ year on HD, (19.14%) were spent from 2-3 years and (28.72%) were spent 4 or more years on HD program. Overall survival rate was (51.1%).

**Conclusions**: No effect of type of vascular access, Dose of hemodialysis, frequency of HD on the outcome of the pediatric patients on chronic HD program enrolled in this study. There is strong correlation between the duration on hemodialysis and outcome.

**Keywords**: Hemodialysis, renal replacement therapy, pediatric
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Introduction

Hemodialysis:-

By the early 1930s, it became clear among pediatric nephrologists in North America and Europe that the care of children with ESRD required separate facilities from those in which adult patients were dialyzed. The concept of specialized pediatric dialysis centers was pioneered in Europe by broyer, scharer, chantler-donkerwolke, rizzoni, and others who stressed the importance of concentrating pediatric ESRD patients in multi-disciplinary pediatric centers specially equipped by experience and expertise to care for children on dialysis and for their families (1). These units were usually attached to university departments of pediatric, as was the case in similar units established in North America. However, no single pediatric center in Europe or North America could hope to treat enough patients to properly develop the therapy.

As a result, the concept of large national and international patient database or registries of children receiving RRT was born. Although a successful transplant is the goal for all paediatric ESRF patient with confirmed survival benefits, episodes of dialysis or long term dialysis may be necessary it is therefore essential to preserve dialysis access, maintain peritoneal membrane function, deliver adequate dialysis, prevent metabolic complications, and ensure adequate nutrition and growth. Cardiovascular risk factors and infectious complications must be minimized, and every support must be offered to ensure continuity of education for the best long term outcome.

Treatment Factors and interventions that may influence both survival and other outcome measures:-

Dialysis access:-

The initial placement and subsequent conservation of either vascular or peritoneal access is critical for the young patient with CKD 5 in whom RRT is a lifelong undertaking. In the NAPRTCS 2003 study, although 68% terminated dialysis as they were transplanted, 20% changed dialysis modality over the 6 year study period. The majority of changes from HD to PD occurred within the first few months; in contrast the change from PD to HD occurred more slowly and was mainly attributable to recurrent infections (2). There was high rate of PD catheter revision (45%) mainly due to catheter malfunction. The access in use after months in children on HD was almost exclusively tunneled catheters in those age less than 6 years, while 57% of those older than 6 years of age were dialysed using an AV fistula or graft. HD access revision rates were very high with 919 revisions among the 584 initial placements, 31% of which were for creation of more permanent access.

Vascular Access:-

Clinical practice guidelines clearly recommend that permanent access as either a native AV fistula or graft is preferred for most children on maintenance HD. If central venous catheters are used (i.e in small or uncooperative children, where HD is initiated before a planned live related transplant or in patients in...
whom early transplantation is anticipated), catheter size. Should be matched to patient size to minimize vessel trauma but allow sufficient flow for adequate HD. External cuffed access should be placed in the internal jugular vein with the tip in the right atrium rather than the subclavian veins where the risk of stenosis is high. The right side is preferred as there is decreased risk of thrombosis and is usually contralateral to the non-dominant arm which may eventually be needed for fistula formation.

If possible all children with CKD stage 3-5 should avoid the use of the non-dominant arm for venopuncture and lines (3). An adult study has shown that HD with any type of venous catheter compared to a graft or fistula increases the risk of both all – cause and infection related mortality (4). Even in small paediatric patients, the use of fistulae or graft is associated with equivalent access survival rates to adult and better survival than cuffed venous catheters (5). In a 20 years retrospective review of 304 paediatric vascular access procedures, the median survival of arteriovenous fistulae is 3.1 years compared to 0.6 years for central venous access (6).

**Dialysis Adequacy:-**

Although the optimal haemodialysisdose has not been defined in children, the renal association and NKF k/ DOQI guidelines agree that children should receive at least the delivered dialysis dose as recommended for adults, that is either a urea reduction ratio (URR) > 65% or an equilibrated Kt/V urea more than 1.2 delivered thrice weekly (7,8).

The HEMO trial in adults showed no difference in survival between patient with a mean ekt/v of 1.16 and those achieving a kt/v of 1.53(9).

These finding are similar to a study in 613 adolescent HD patients in which hospitalization risk was increased with a single pool kt/v < 1.2 compared to 1.2 -1.4 but a spkt/v of > 1.4 did not further improve outcome (10).

However, in a smaller study of 12 children receiving a carefully controlled dietary intake with a mean kt/v of 2 and mean URR=84.7%, catch up growth was demonstrated (11). Increasing the frequency of HD sessions has been shown to significantly improve appetite and increase growth velocity in a small paediatric study, may lead to a re-evaluation of dialysis adequacy inchildren(12). Certainly in adults, short dialy or nocturnal home or in – centre dialysis has been shown to improve well – being and cardiovascular out come(13,14). By adding convective clearance to conventionalhaemodialysis, haemiodiafiltration has been shown to be a superior dialysis modality in two large adult studies with significantly improved clearance of beta -2 microglobulin and 35% better survival .

These findings may translate in the future to improved outcomes for children on dialysis(15).

**Patients and Methods**

A multicenteric descriptive, observational cross – sectional study of all chronic hemodialysis patients who started dialysis in pediatric age, in hemodialysis centers in AL kharkh side of Baghdad city extended between January of 2011 to the 31 of December 2014. We collected 94 patients undergoing hemodialysis in 3 centers:-

- Al – Karama teaching hospital center.
- Al – Zohoor center in pediatric teaching hospital
Clinical and laboratory data were obtained from medical records and from data collected from patients by direct interview with each patient during hemodialysis session and by questionnaire.

The patient population includes all children younger than 20 years old who survived at least 90 days after starting hemodialysis.

Patient were excluded from the study if they underwent transplantation but returned to dialysis. Cases whose medical records were not available were excluded.

Children with aprior kidney transplantation were excluded (preemptive transplanted patients were excluded). There is deficient in the three centers ranging from missing some information like basic or clinical data to miss whole medical record which was excluded from the study.

Factors that may influence outcome including treatment factors like type of vascular access, Dose of hemodialysis, Frequency of sessions, duration on hemodialysis

**Data Statistical analysis**

Statistical analysis was performed using spss – 21 (statistical packages for social sciences – version 21) and Microsoft office excel (Microsoft office Excel for windows; 2010). One way analysis of variance (ANOVA) and student t-test was used to assess significant difference among means in regards with duration. Proportions were compared by chi-square, P < 0.05 was considered statistically significant.

**Results**

During the period of study, a total number of 94 patients undergoing chronic hemodialysis were studied according to patients demographics data, where the age group ≤ 7 years were (26.6%) while these ≥ 14 years were (7.44%).

Male form (63.82%) while female (36.17%). (75.5%) of patients were from Baghdad city.

Table (3.1) show the distribution of patients according to treatment factors.

According to the type of vascular access, those with CVC were (71.27 %) whereas those with AVF were (28.72%).

According to the frequency of hemodialysis, those who have twice sessions per week were (43.61%), whereas those with thrice sessions per week comprise (56.38%).

According to the dose of hemodialysis, those who spent 3 hr per session were (61.70%), whereas those who spent 4 hr per session were (38.29%).

According to duration on Hemodialysis those who have a survival time on HD for ≤ 1 year were (47.87%), those who have a survival time on HD for 2-3 years were (42.55%) while those who have a survival time on HD for 4 years were (9.57%).
<table>
<thead>
<tr>
<th>Variable</th>
<th>No</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of vascular access</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CVC</td>
<td>67</td>
<td>71.27</td>
</tr>
<tr>
<td>AVF</td>
<td>27</td>
<td>28.72</td>
</tr>
<tr>
<td>Overall</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td><strong>Frequency of hemodialysis \wk</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twice</td>
<td>41</td>
<td>43.61</td>
</tr>
<tr>
<td>Thrice</td>
<td>53</td>
<td>56.38</td>
</tr>
<tr>
<td>Overall</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td><strong>Dose of hemodialysis</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 hr / session</td>
<td>58</td>
<td>61.7</td>
</tr>
<tr>
<td>4 hr / session</td>
<td>36</td>
<td>38.2</td>
</tr>
<tr>
<td>Overall</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td><strong>Duration on hemodialysis (vintage)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 1 year</td>
<td>45</td>
<td>47.87</td>
</tr>
<tr>
<td>2- 3 years</td>
<td>40</td>
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<tr>
<td>4 years</td>
<td>9</td>
<td>9.57</td>
</tr>
<tr>
<td>Overall</td>
<td>94</td>
<td></td>
</tr>
</tbody>
</table>

Table (3.2) shows the distribution of patients according to outcome.

48 (51.1%) of our patients were alive, 34 (70.8%) of them still on hemodialysis till the time of the end of the study, 2 (4.1%) were stop hemodialysis (improved), and 12 (25%) were transplanted.

46 (48.9%) of our patient were died. The median survival time of patients who died during follow up was 2 years.

Table (3.2) distribution of patients according outcome

<table>
<thead>
<tr>
<th>Variable</th>
<th>No</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alive</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Still on H.D</td>
<td>48</td>
<td>51.1</td>
</tr>
<tr>
<td>• Stop H.D</td>
<td>34</td>
<td>70.8</td>
</tr>
<tr>
<td>• Transplanted</td>
<td>2</td>
<td>4.1</td>
</tr>
<tr>
<td>Dead</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transplanted</td>
<td>12</td>
<td>25</td>
</tr>
<tr>
<td>Overall</td>
<td>46</td>
<td>48.9</td>
</tr>
</tbody>
</table>

**Correlation between treatment factors and patients outcome.**

Fig (3.1) shows the correlation between the type of vascular access and outcome where in patients with CVC (71.27%); (53.7%) were alive and (46.3%) were dead.

While in patients with AVF (28.72%); (44.4%) were alive and (55.6%) were dead.

(P. value = 0.0928 which is NS)

So there is no correlation between the type of vascular access and outcome.
Fig (3.1) Correlation between the type of vascular access and the patients’ outcome.

Fig (3.2) shows the correlation between the frequency of hemodialysis sessions and the patients outcome where in those who have twice sessions per week (43.61%); (43.9%) were alive and (56.1%) were dead. While in those who have thrice sessions per week (56.38%); (56.6%) were alive and (43.4%) were dead. (P. value = 0.2218 which is NS) so there is no correlation between the frequency of sessions and patients outcome.

Fig (3.2) Correlation between the frequency of hemodialysis sessions on patients outcome.

Fig (3-3) shows the correlation between the Dose of hemodialysis and patients outcome, where in those who spent 3 hrs/session (61.7%), (50%) of them were alive, and (50%) were dead, while in those who spent 4 hrs/session (38.2%), (52.8%) were alive and (47.2%) were dead.

(P.value=0.79 which is NS) so there is no correlation between the dose of hemodialysis and the patients outcome.

Fig (3.3) Correlation between the Dose of hemodialysis and patients outcome.

Fig (3.4) shows the correlation between the duration on hemodialysis(length of time on hemodialysis) and the patients outcome where in those who have a survival time on hemodialysis for one or less year (47.87%); (0.90±0.04) were alive and (0.90 ± 0.04) were dead.

In those who have survival time on hemodialysis for 2-3 years (42.55%); (2.52± 0.11) were alive and (2.47± 0.11) were dead.

While in those who have survival time on hemodialysis for 4 years (9.57%); (4.25± 0.25) were alive and (4.00 ± 0.10) were dead.

(P. value < 0.05 which is S)

So there is strong correlation between the length of time on hemodialysis and patients outcome.

Fig (3.4) Correlation between the duration on hemodialysis and patients outcome.
Discussion

This study performed in three Hemodialysis centers in Al-Kharkh side of Baghdad to outline the outcome of Long – term chronic Hemodialysis program in pediatric patients. And to identify the most important risk factors that may affect the outcome of them. In this study, we found that the majority of pediatric chronic hemodialysis patients receive their dialysis by way of a venous catheter (71.27%) as opposed to an AVF (28.72%). This finding goes with the finding of Alicia et al. (16) which shows that the patients with CVC were (61%), whereas AVF (31%) or AVG (8%). There is no correlation between the type of vascular access and patients outcome in our study. This finding disagreed by the result of Rita D et al study which shows improved survival rates with the use of BothAVF and AVG than cuffed venous catheters in pediatric patients in chronic hemodialysis program. (17). In this study, we noticed that (43.61%) of our sample study received their hemodialysis twice weekly. While (56.38%) Do so thrice weekly. This finding is slightly similar to the finding of F.Z. Souilmietal study in Morocco (18) in which the number of dialysis sessions per week was three sessions in 49 patients (68%) and two sessions in 23 patients (23%). Our study reveals no association between the number or frequency of dialysis sessions and patients outcome. This result goes with the result of Raymond M. hakim et al study (19) which concludes in favor of conventional three times per week dialysis but at long dialysis time than is currently prescribed based on the Kt/V metric alone. This study attempts to balance the potential benefits of more frequent dialysis with burden on the patients lifestyle, an increased risk of access malfunction, as well as social cost of such intensive dialysis prescriptions. Other studies show a significant correlation in contrast to our finding. As shown in Robert N. Foley et al study which reveal that the long (2-day). Interdialytic interval is a time heightened risk among pediatric receiving hemodialysis (20). Other study by the FHN trial group, shows that frequent hemodialysis, as compared with conventional hemodialysis, was associated with favorable results with respect to the composite outcomes of death or change in left ventricular mass and death or change in a physical – health composite score but prompted more frequent interventions related to vascular access. (21). Probably the reason behind our result due to the presence of other risk factors that overcome the effect of this factor.In this study, we use dialysis time as an important measure of dialysis adequacy. So regarding the dose of hemodialysis (61.7%) of our sample study spent 3hr / session, while (32.2%) spent 4 hr/ session. With no significant correlation between session length and patients outcome. Similar finding was reported by the national cooperative dialysis study (NCDS) (22). And HEMO trial (23) where increase in dialysis session length of similar or greater magnitude failed to improve survival. Miller et al study (24) found no benefit in terms of survival of dialysis sessions lasting longer than 3.5 hr. This result is disagreed with the result of Flythe et al report (25)Who found a substantial mortality increase associated with slightly shorter prescribed session length; and Saran et al study (26) which found that longer dialysis sessions were indeed associated with increased survival. On the other hand, In term of blood pressure and volume control and it is positive effect on survival, Chazot C et al(27) found better volume control is almost certain to occur with longer treatments and better control of blood pressure, decreased need for antihypertensive medication, fewer intradialytic hypotensive episodes, and reduced mortality associated with longer treatment.

The amount of benefit obtainable by moderate increase in dialysis time in patients following a three-times-per-week schedule has not been well established, and the analysis is confounded by associations between prescribed and or delivered dialysis time and factors related to pediatric mortality(28). The reason behind that majority of our patients spent 3 hr\ session is related to the patient himself, almost all our patient can not tolerate 4hr session and they may suffer hypotensive episodes with increased session time. Regarding the duration on Hemodialysis (Vintage), (47.87%) of our sample study receive their hemodialysis for ≤ year, (42.55%) spent from 2-3 years, and (9.57%) were spent 4 years on hemodialysis programs. While in a study done by Alicia M. et al, reveal a lower percentage of patients on dialysis for less than 6 months versus 6 months or longer (72%) vs (92%). (16). This study shows significant correlation between the vintage and the patients outcome. This finding goes with the finding of Groothoff et al study (29) and Rukshana Shroff et al study (30). Which reveal that the vintage were associated with increase mortality. This result is disagreed by the UK renal registry (31) which reports that the risk of death does not differ significantly with increasing length of time on dialysis.

Conclusions

1. No effect of type of vascular access, Dose of hemodialysis, frequency of HD on the outcome of the pediatric patients on chronic HD program enrolled in this study.

2. There is strong correlation between the duration on hemodialysis and outcome.

References


7. Pastan S, soucie JM, Mcclellan WM. Vascular access and increased risk of death among hemodialysis patients. Kidney int. 2002;62(2).

29. The FHN trial group in center hemodialysis six times per week versus three times per week. N en gl J med 2010; 363(24): 2287-300.