

Association of Cardiovascular Complications in Children Undergoing Hemodialysis at a Tertiary Care Hospital

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Abstract

Background: Chronic kidney disease is a global health problem which is related with significant disease morbidity. Hemodialysis is a life saving modality but it is also associated with certain cardiovascular complications which do compromise quality of life of these patients. This study was conducted to document the frequency of such complications in patients on hemodialysis. **Objective:** To Determine the Frequency of Acute Cardiovascular Complications during Hemodialysis. **Material and Methods:** The patients going for dialysis were completely assessed clinically by the doctor before the start of procedure. Continuous monitoring of BP, Pulse and ECG was done during the whole procedure using cardiac monitor, readings were recorded every 30 minutes. **Results:** Mean age of our study cases was 11.31 ± 2.63 years. Of these 231 study cases, 154 (66.7%) were boys while 77 (33.3%) were girls. Mean duration of the disease was 16.78 ± 9.42 months. Mean duration on hemodialysis was 11.91 ± 7.06 months. Of these 231 study cases, 127 (54.97%) were from rural areas and 104 (45.03%) were from urban areas. Arrhythmia was seen in (3.9%), intradialytic hypotension in 39 (16.9%) and intradialytic hypertension in 48 (20.8%) of our study cases. **Conclusion:** Intradialytic Hypertension and hypotension are the major complications of the hemodialysis in our study. Cardiovascular complications were significantly associated with disease duration and duration on hemodialysis. Early diagnosis and proper monitoring of these patients can help reduce disease morbidity and improve quality of life of these patients.

Keywords: acute complications, hemodialysis, arrhythmia.

Introduction:

Chronic kidney disease is defined as renal injury (proteinuria) and/or glomerular filtration rate (GFR) less than $60 \text{ ml}/1.73 \text{ m}^2$ for more than 3 months.¹ Chronic kidney disease (CKD) is a common public health problem. The prevalence of CKD in pediatric population is approximately 18 per million. CKD in children less than 5 years is mostly due to congenital abnormalities, others causes are congenital nephrotic syndrome, cortical necrosis, focal segmental glomerulosclerosis, autosomal recessive polycystic kidney disease, renal vein thrombosis and HUS. While after 5 years of age glomerulonephritis, juvenile nephronophthisis, alport syndrome predominate while autosomal recessive and autosomal dominant polycystic kidney disease can occur throughout the child hood.² The prognosis of children with CKD is improved markedly due to improved medical management including aggressive nutritional support, recombinant erythropoietin, recombinant growth hormone administration along with renal replacement therapy.² CKD is staged 1-5 based on GFR.² CKD 5 (GFR $<15 \text{ ml}/\text{min}/1.73 \text{ m}^2$) patients cannot survive without some form of renal replacement therapy (RRT) i.e. peritoneal dialysis, hemodialysis and renal transplant. Hemodialysis is the most successful and most widely used form of renal replacement therapy. Its success and worldwide use attest to its safety; about 54% children more than 12 years of age with CKD 5 are treated with hemodialysis worldwide.³

The primary goal of hemodialysis is to restore the intracellular and extracellular fluid environment that is characteristic of normal kidney function.⁴ Hemodialysis is accompanied by several complications among which cardiovascular complications are currently the most common among these hypotension, hypertension and arrhythmias are mostly encountered.¹⁰ In patients with CKD 5 undergoing dialysis, the mortality rate from cardiovascular complications is 10-100 fold greater than in general population.⁵ Improved dialysate delivery systems, more reliable monitoring devices, and automated safety mechanisms in hemodialysis equipment have reduced the risk of these complications.⁶ In a study from the Children's Hospital & the Institute of Child Health, Lahore in 2005, the frequency of hypotension was 3.46%, hypertension 40.46% and arrhythmia 0.19% during hemodialysis.⁷ In a study published in 2013 from Hamdard University, Karachi, the frequency of hypotension was 86% and arrhythmias 41% during hemodialysis.⁸ In a study published in 2012 from Nepal, the frequency of intradialytic hypotension was 4.5% and intradialytic hypertension was 3.9%.⁹ In a book published from Turkey in 2011, the frequency of hypotension, hypertension and arrhythmias was 44%, 12-13% and 17-76% respectively during haemodialysis.¹⁰

A study was done at University College London Centre for Nephrology, UK in 2006, which showed the frequency of hypotension <5%-40% and arrhythmias 50% during hemodialysis.¹¹ A study showed the frequency of hypotension 55%, arrhythmias 15% and hypertension 7% during hemodialysis.¹²

Materials and Methods:

Total of 231 study cases undergoing hemodialysis aged less than 16 years were included in our study at Department of Pediatrics, Jinnah Hospital Lahore. Patient with any structural heart disease, cardiomyopathy, AKI and having any cardiac arrhythmias prior to dialysis were excluded from our study. The parents/guardians were detailed about the procedure and the written informed consent was taken. Bio-data including age, gender, weight and duration of dialysis along with date and time and registration will be recorded. The patients going for dialysis were completely assessed clinically by the doctor before the start of procedure. Continuous monitoring of BP, Pulse and ECG was done during the whole procedure using cardiac monitor, readings were recorded every 30 minutes. If any complication occurs during hemodialysis, it was managed and outcome variables i.e. hypotension, hypertension and arrhythmias were recorded by the doctor. **Intradialytic Hypotension** was defined as sudden drop in systolic blood pressure more than 20mm of Hg than pre dialysis reading of systolic blood pressure at any time during hemodialysis. Intradialytic Hypertension was defined as increase in systolic blood pressure more than 20mm of Hg or increase in diastolic blood pressure more than 10mm of Hg than pre dialysis reading of blood pressure at any time during hemodialysis. Arrhythmia: Children were monitored with ECG monitor continuously during hemodialysis. The following two arrhythmias determined on ECG patterns were taken as arrhythmias at anytime during hemodialysis i.e. Atrial Fibrillation and ventricular Tachycardia. Data was entered in SPSS-22 for analysis.

Results:

Our study comprised of a total of 231 children on hemodialysis meeting inclusion criteria of our study. Mean age of our study cases was 11.31 ± 2.63 years ranging from 5 years to 15 years while 144 (62.3) aged more than 10 years.

Of these 231 study cases, 154 (66.7%) were boys while 77 (33.3%) were girls. Mean age of the boys was 11.46 ± 2.55 years while that of girls was 11.01 ± 2.77 years ($p = 0.224$). Mean duration of the disease was 16.78 ± 9.42 months ranging from 7 months to 30 months while 130 (56.28%) had disease for more than 12 months. Mean duration on hemodialysis was 11.91 ± 7.06 months. Our study results have further indicated that majority of study cases i.e. 155 (67.10%) were on dialysis for more than 6 months. Of these 231 study cases, 127 (54.97%) were from rural areas and 104 (45.03%) were from urban areas. Mean weight of the study cases was 24.97 ± 15.88 kilograms. Pre-dialysis mean systolic blood pressure was 128.43 ± 21.94 mm Hg while diastolic blood pressure was 78.64 ± 21.44 mm Hg. Mean systolic blood pressure during hemodialysis was 131.05 ± 16.32 mm Hg while diastolic blood pressure was 73.6 ± 14.8 mm Hg. Arrhythmia was seen in 9 (3.9%), intradialytic hypotension in 39 (16.9%) and intradialytic hypertension in 48 (20.8%) of our study cases.

Discussion:

Our study comprised of a total of 231 children on hemodialysis meeting inclusion criteria of our study. Mean age of our study cases was 11.31 ± 2.63 years ranging from 5 years to 15 years while 144 (62.3) aged more than 10 years. A study conducted by Hafeez et al ⁷ at Lahore also reported 11.06 years mean age of children on hemodialysis, these findings are in compliance with that of our study results. Shin et al ¹³ reported 10.1 ± 4.6 years mean age of the patients on hemodialysis which is same like our study results.

Of these 231 study cases, 154 (66.7%) were boys while 77 (33.3%) were girls. Mean age of the boys was 11.46 ± 2.55 years while that of girls was 11.01 ± 2.77 years ($p = 0.224$). Shaikh et al ¹⁴ reported 66 % male gender predominance. Shin et al ¹³ reported 56.5 % boys showing male gender predominance. The risk of cardiovascular diseases increases with prolonged duration of the disease ^{7, 8, 15, 16} Mean duration of the disease was 16.78 ± 9.42 months ranging from 7 months to 30 months while 130 (56.28%) had disease for more than 12 months. In our study the risk of cardiovascular diseases was significantly associated increasing disease duration of CKD. Mean duration on hemodialysis was 11.91 ± 7.06 months. Our study results have further indicated that majority of study cases i.e. 155 (67.10%) were on dialysis for more than 6 months. Furthermore our study results have indicated that the cardiovascular diseases were associated with duration on hemodialysis.

Intradialytic hypertension in 48 (20.8%) of our study cases. So the results of our study indicated that intradialytic hypertension was the major cardiovascular complication in our study. A study conducted by Hafeez et al ⁷ also reported intradialytic hypertension being more prevalent in 40.6 % children on hemodialysis which was in compliance with that of our study findings. Another study by Hassan et al ¹⁷ reported 28 % intradialytic hypertension which is similar to that of our study results. Arrhythmia was seen in 9 (3.9%). Hafeez et al ⁷ reported 0.19 % arrhythmias in the children with hemodialysis. These findings are close to our study results. Another study by Ahmed et al ¹² reported 15 % arrhythmia which is higher than that of our findings. Intradialytic

hypotension in 39 (16.9%) and Hafeez et al from Lahore ⁷ reported 3.4 % intradialytic hypotension which is less than that of our study results. Shaikh et al ¹⁴ reported 5.84 % intradialytic hypotension. Agarwal et al ⁹ reported 4.5 % hypotension from Nepal.

Conclusion:

Intradialytic Hypertension and hypotension are the major complications of the hemodialysis in our study. Cardiovascular complications were significantly associated with disease duration and duration on hemodialysis. Early diagnosis and proper monitoring of these patients can help reduce disease morbidity and improve quality of life of these patients.

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