Summary

Acute hemodynamic changes are still the most frequent complications during hemodialysis (HD) treatment. This causes discomfort, reduces treatment efficacy, and thus increases long-term cardiovascular problems and consequently the morbidity of these patients. One of the common clinical manifestations of hemodynamic instability during hemodialysis is hypotension.

Pulsed wave Doppler echocardiography plays an important rule in the evaluation of the diastolic filling pattern of the left ventricle (LV).

This study was conducted at HD unit, pediatric department, Benha university hospital and kafr shukr general hospital HD unit.

The aim of this study was to examine the effect of net volume ultra-filtrate loss (measured by the hemodialysis machine) during hemodialysis on the diastolic and systolic indices of left ventricle by pulsed Doppler echocardiography and the systolic flow of the aortic valve and to validate the best derived parameter of Doppler indices in order to predict those patients who may have tendency to develop hypotension during hemodialysis so as to ensure better outcome and decrease complications.

This study included a total of 20 patients with ESRD on regular HD for more than 6 months, 3 times/week at HD unit, pediatric department, Benha university hospital and kafr shukr general hospital HD unit. The diseased patients were divided into two groups, I & II.

Patients with severe mitral or aortic valve disease, patients with LV systolic dysfunction with LV ejection fraction of less than 50% or patients not willing to participate were excluded from the study.

Twenty normal persons were taken as a control.

The patients and control were subjected to:

1. Initial assessment including: History taking, clinical examination.
2. Careful hemodynamic follow up of blood pressure and heart rate during and after hemodialysis, with monitoring of any cardiac events during hemodialysis.
3. Investigations*:* including ECG, Echocardiography pre and post dialysis including M-mode & pulsed Doppler echocardiography.

The diseased group included 7 males (35%) and 13 females (65%), while the control group included 7 males (35%) and 13 females (65%). For age, the mean age in the diseased group was 15.2±2.7 years (ranging from 10 to 18 years) and was 14.6±2.9 years in control group.

The topography of both the diseased & the control groups were comparable to each other with no statistically significant difference between both groups as regard age, sex or body mass index.

The diseased group was divided to two groups, group I included 11 patients while group II included 9 patients.

Group I include patients whose ultrafilteration volume was < 2 liters at the end of hemodialysis session (mean volume 0.8±0.4 Liters), while group II include patients whose ultrafilteration volume was ≥ 2 liters at the end of hemodialysis session (mean volume 2.9±0.9 Liters).

When analyzing the data comparing the control group with the diseased group, there was a significant impact of LV diastolic dysfunction and decreased LV compliance. This is detected by increased A velocity in the diseased group & decreased E/A ratio with mean value of E/A ratio1.6±0.1 in the control group while it was low in the diseased group(0.9±0.2).

The other issue is the increased predialysis Vena cava diameter in the diseased group denoting increased blood volume in the diseased group due to fluid retention.

Comparing diseased group I & II, no statistical differences between both groups in regard to age, sex, predialysis heart rate, blood pressure, and body mass index. The hydration status pre dialysis was similar in both groups, as assessed by predialysis measurement of inferior vena cava diameter (VCD) which was 9.6±1mm in group I & 10±1mm in group II.

The post-dialysis data of M mode echo and Pulsed Doppler indices in the study patients showed a trend towards reduction of all Doppler indices except DT of E wave, which was prolonged. In Group II, the reduction in the mean value of E wave velocity, E/A ratio and Time velocity integral of aortic valve (TVI) and the prolongation of DT of E wave were of statistical significance.

In the current study, comparing the post-dialysis LV end-diastolic dimension in the two groups, group I shows no significant changes in LVEDD or LVESD with no significant changes in EF % , while group II patients showed significant reduction of LVEDD by 0.45 cm coupled with mild decrease of LVESD with resultant an increment of the left ventricular ejection fraction by about 3 % in Group II.

In the present study, the decrease of inferior vena cava (IVC) diameter wasn't statistically significant in group I (decreased from 9.6 mm to 9.3 mm, P value > 0.05). In contrast, the decrease in inferior vena cava diameter was significant in group II (decreased from 10 mm to 8.5 mm, P value < 0.05). This signifies a more reduction in the volume status leading to decreased venous return and reduction of inferior vena cava diameter.

Analyzing vital changes of both groups, there was more reduction in systolic blood pressure after dialysis with group II patients more than group I (Group I changed from 116.4 mmHg to 108.2 mmHg, P >0.05 while in group II, there was a more significant reduction of systolic blood pressure from 104.4 mmHg to 88.9 mmHg post dialysis, , P < 0.05).

In the present study, 6 patients (30%) developed single or multiple episodes of intra dialysis hypotension towards the end of hemodialysis session. It is observed that 44% of group II developed hypotension, in contrast to only 18% of group I.

When analyzing patients who developed hypotension during the current study, they were characterized by a significant reduction of preload Doppler indices in the form of decreased LVEDD by about 0.3 cm associated with a little change of LVESD, resulting in an increment of LVEF% by about 3%. These changes are less pronounced in the patients who didn't develop hypotension who were characterized by less change without significant increment in EF%.

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The patients who developed hypotension in the current study showed a significant reduction of E velocity with a little decrease in A velocity with a significant reduction of E/A ratio from 0.8±0.1 to 0.5±0.1 after hemodialysis, in contrast to the patients who didn't develop hypotension whose E/A ratio decreased from 0.9±0.1 to 0.83±0.16 post dialysis.

There was also a more reduction of TVI of aortic valve with more prolongation of deceleration time to about 244.6±9.2.

It is recommended that the patients on chronic hemodialysis should be carefully monitored for hemodynamic stability for possibility of development of intra dialysis hypotension as it could be a serious problem which needs to be carefully diagnosed and managed.

Another issue is careful assessment of the patient, pre-, intra- and post-dialysis, with respect to pre dialysis Doppler indices especially on planning large preload reduction for detection of those at increased risk of developing hypotension.