VOLUME - 12, ISSUE - 01, JANUARY - 2023 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

General Medicine

# A COMPATITIVE STUDY OF PLATELET DISTRIBUTION WIDTH AND MEAN PLATELET VOLUME IN CHRONIC KIDNEY DISEASE PATIENTS ON HAEMODIALYSIS AND NOT ON HAEMODIALYSIS

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**ABSTRACT** Chronic kidney disease (CKD) is a gradual and progressive loss of renal function over time. Among the many complications associated with CKD, its impact on platelet functions is significant. The present study was conducted to evaluate and compare platelet distribution width and mean platelet volume among CKD patients on HD and those not on HD. The study was conducted on a total of 100 patients {50 each, of CKD (Not on haemodialysis) and End stage renal disease (on haemodialysis)}. When assessed according to the platelets, it was observed that the platelet distribution width and mean platelet volume were significantly higher in the NOT ON HD group than the ON HD group. It can be concluded from the study that as the serial values of PDW and MPV decreases, the chances of CKD (NHD) patients requiring haemodialysis in the future increases.

**KEYWORDS :**

## INTRODUCTION

CKD is a condition characterized by a gradual loss of kidney function over time. The stages of kidney disease are based on how they filter waste and extra fluid out of the blood. In the early stages of kidney disease, kidneys are still able to filter out waste from the blood. In the later stages, kidneys have to work harder to get rid of waste, and may stop working altogether. CKD is identified and defined by the presence of an abnormality of kidney structure or function (or both) present for at least 3 months.[1]

It has been observed that early stages of CKD (not on haemodialysis) are typically associated with a prothrombotic tendency, whereas in its more advanced stage patients also suffer from a bleeding diathesis.[2] The balance between thrombosis and bleeds is disturbed in CKD(not on HD). Though studies have been conducted and the underlying pathophysiologic mechanism for platelet dysfunction in chronic uremic state have been outlined, however, the studies regarding the effect of dialysis on platelet function are scarce. Therefore, the present study was conducted to evaluate and compare the platelet distribution width and mean platelet volume amongst the CKD(not on HD) and ESRD patients on HD.

## AIMS AND OBJECTIVES

- To assess platelet distribution width and mean platelet volume in chronic kidney disease patients.
- To study the effect of dialysis on platelet indices.

## MATERIALS AND METHOD

This cross-sectional observational study was conducted under the Department of Medicine, MGM Institute of Health Sciences, Navi Mumbai. Prior approval of Institutional Ethics Committee was taken before start of the study. A written signed informed consent was taken from all the patients prior to their enrolment in the study.

### Duration of Study:

March 2020 – October 2021

### Study Population:

Patients attending Medicine OPD and already diagnosed with CKD, and meeting the inclusion and exclusion criteria were included in the study.

### Inclusion Criteria:

1. Patients of either gender, aged more than 18 years.
2. All CKD patients with eGFR less than or equal to 60 ml/min
3. End stage renal disease patients on haemodialysis irrespective of the number of previous haemodialysis.

### Exclusion Criteria:

1. Patients on antiplatelet drugs.
2. Patients with underlying disorders that affect platelet functions like HIV, Hepatitis B, Hepatitis C, ITP.
3. Patients with acute illness.
4. Pregnant women.
5. Patients who did not consent to participate in the study.

### Sample Size:

100 patients of either gender, presenting in the Medicine OPD and diagnosed with CKD, were included in the study. The study included 50 patients in each group (50 patients not on haemodialysis and 50 patients on haemodialysis).

### Sampling Technique:

All consecutive patients diagnosed with CKD presenting in Medicine OPD during the study period and who met the inclusion and exclusion criteria, were included in the study. Consecutive patients consenting to participate in the study were included, until the desired sample size of 50 patients in each group was met. Venous blood was collected for laboratory investigations. Laboratory investigation of platelet indices was done on XP-100/XN-1000 HEMATOLOGY machine. The investigations were done in biochemistry laboratory of MGM Institute of Health sciences, Navi Mumbai.

### Ethical Considerations:

Prior approval of the Institutional Ethics Committee was taken before conducting the study.

### Statistical Analysis:

The data was analysed using statistical software IBM SPSS.

## OBSERVATIONS AND RESULTS

In this study, a total of 100 patients (50 patients of CKD not on haemodialysis and 50 patients of end stage renal disease on haemodialysis) were taken. The patients were included in two groups on the basis of eGFR and haemodialysis:

1. Patients with eGFR between 15 to 60 mL/min/1.73m2 and not on haemodialysis: Group "NOT ON HD"
2. Patients with eGFR less than 15 mL/min/1.73m2 and on haemodialysis: Group "ON HD"

The PDW in the patients NOT ON HD was 13.47 ± 2.32 %, whereas in those ON HD was 11.32 ± 2.84 %. MPV in cases of NOT ON HD was 11.10 ± 0.82 fL while in cases of ON HD, it was 10.20 ± 1.61 fL.

The analysis showed that 16 patients had HTN in NOT ON HD group while 42 patients had HTN in ON HD group. The PDW in hypertensive patients in NOT ON HD group was 13.47 ± 2.25%, whereas the PDW in ON HD group was 11.28 ± 2.56%. The MPV in hypertensive patients in NOT ON HD group was 11.31 ± 0.94 fL, whereas the MPV in ON HD group was 10.04 ± 1.61 fL,

A total of 22 patients had DM in NOT ON HD group while 18 patients had DM in ON HD group. The PDW in diabetic patients in NOT ON HD group was 13.29 ± 2.41%, whereas the PDW in ON HD group was 12.34 ± 3.33%. The MPV in diabetic patients in NOT ON HD group was 11.02 ± 1.00 fL, whereas the MPV in ON HD group was 9.94 ± 2.31 fL.

Further analysis revealed that 11 patients had HTN and DM both in NOT ON HD group while 15 patients had HTN and DM both in ON HD group. The PDW in NOT ON HD group was 13.24 ± 2.37%, whereas the PDW in ON HD group was 11.86 ± 3.28%. The MPV in NOT ON HD group was 11.25 ± 1.04 fL, whereas the MPV in ON HD group was 9.72 ± 2.44 fL.

A total of 22 patients did not have any comorbidities in NOT ON HD group and 18 patients were without comorbidities in ON HD group. The PDW in NOT ON HD group was 13.30 ± 2.20%, whereas the PDW in ON HD group was 9.5 ± 3.82%. The MPV in NOT ON HD group was 11.10 ± 0.66 fL, whereas the MPV in ON HD group was 10.98 ± 1.75fL.

**Table 1: PDW and MPV according to the presence of dialysis**

| PARAMETER | NOT ON HD | ON HD | MEAN | P Value |
|---|---|---|---|---|
| PDW (%) | 13.47 ± 2.32 | 11.32 ± 2.84 | 12.39±2.80 | <0.001 |
| MPV (fL) | 11.10 ± 0.82 | 10.20 ± 1.61 | 10.65±1.35 | 0.001 |

**Interpretetion:**
The PDW and MPV were significantly more in the 'NOT ON HD' group than in the 'ON HD' group (P value: less than 0.05).

**Table 2: Distribution Of Pdw With Comorbidities**

| PDW | NOT ON HD (in %) | ON HD (in %) | P VALUE |
|---|---|---|---|
| HTN | 13.47 ± 2.25 | 11.28 ± 2.56 | 0.004 |
| DM | 13.29 ± 2.41 | 12.34 ± 3.33 | 0.307 |
| HTN + DM | 13.24 ± 2.37 | 11.86 ± 3.28 | 0.249 |
| NO COMORBIDITIES | 13.30 ± 2.20 | 9.5 ± 3.82 | 0.005 |

**Interpretetion:**
There was no significant difference in PDW between the two groups in the cases of DM and cases having DM and HTN. PDW was significantly higher in the NOT ON HD group amongst the cases having HTN and cases with no comorbidities.

**Table 3: Distribution Of Mpv With Comorbidities**

| MPV | NOT ON HD (in fL) | ON HD (in fL) | P VALUE |
|---|---|---|---|
| HTN | 11.31 ± 0.94 | 10.04 ± 1.61 | 0.005 |
| DM | 11.02 ± 1.00 | 9.94 ± 2.31 | 0.055 |
| HTN + DM | 11.25 ± 1.04 | 9.72 ± 2.44 | 0.063 |
| NO COMORBIDITIES | 11.10 ± 0.66 | 10.98 ± 1.75 | 0.800 |

**Interpretetion:**
There was no significant difference in the MPV between the two groups in the cases of DM, cases having DM and HTN and cases with no comorbidities. MPV was significantly higher in the NOT ON HD group amongst the cases having HTN.

## DISCUSSION

Platelet dysfunction in CKD patients have been studied since long. Platelets have an important function of maintaining hemostasis. In CKD patients, bivariant platelet dysfunction is observed leading to both bleeding diathesis and thrombosis. Though several pathogenic mechanisms have been hypothesized, however, the effect of dialysis is less studied.

The volume of platelets in the bloodstream is heterogeneous, and their structures and metabolic functions differ. Typically, the average mean cell volume is 7.2–11.7 fL in healthy subjects.[3,4] MPV measures the size of the circulating platelets. MPV is determined in the progenitor cell, the bone marrow megakaryocyte. The platelet volume is found to be associated with cytokines that regulate megakaryocyte ploidy and platelet number and result in the production of larger platelets.[5,6] When platelet production decreases, young platelets become bigger and more active, and MPV levels increase. Increased MPV indicates increased platelet diameter, which can be used as a marker of production rate and platelet activation. During activation, platelets' shapes change from biconcave discs to spherical, and a pronounced pseudopod formation occurs that leads to MPV increase during platelet activation. Large platelets are generally younger with more reactive granules to induce adhesion and aggregation. Therefore, increased MPV was introduced as an indicator of platelet reactivity, atherosclerosis, and inflammatory status.[7,8] Studies have reported decreased MPV, particularly in cases of ESRD.[9] Koroglu M. et al[10] observed a high MPV in CKD patients and lower PDW in healthy than CKD patients but no significant difference of healthy with ESRD patients.

PDW is an indicator of volume variability in platelets size and is increased in the presence of platelet anisocytosis.[6] PDW is a distribution curve of platelets measured at the level of 20% relative height in a platelet-size distribution curve, with a total curve height of 100%.[11] The PDW reported varies markedly, with reference intervals ranging from 8.3 to 56.6%.[12-14] PDW directly measures variability in platelet size, changes with platelet activation, and reflects the heterogeneity in platelet morphology[9].

In the present study, the PDW was significantly higher in the patients NOT ON HD (13.47 ± 2.32 %) than in those ON HD (11.32 ± 2.84 %); P value: less than 0.001. Similarly, MPV was significantly higher in cases NOT ON HD (11.10 ± 0.82 fL) than in cases ON HD (10.20 ± 1.61 fL); P value: 0.001.

When assessed with comorbidities, there was no significant correlation in the two groups amongst the cases having DM in the two groups. Amongst the cases having HTN, PDW and MPV were significantly higher in the NOT ON HD group; P value: less than 0.05. Amongst the cases having DM and HTN, there was so significant difference in the two groups. Amongst the cases not having DM and HTN, PDW was significantly higher in the NOT ON HD group; P value: 0.005.

In the study by Yu Z. et al[15], they observed that the PDW decreased with progression in the stage of CKD; P value: less than 0.05. This was similar to the present study where lower values of PDW were found in the patients ON HD as they were mostly cases of higher stages of CKD/ESRD. In the study by Lokesh S. et al[16], they observed that the PDW was significantly

higher in the control group of healthy individuals as compared to cases with ESRD on HD; P value: 0.006. This was similar to the present study. Schrool M. et al[17,18] observed a post-hemodialysis decline in PDW as compared to pre-hemodialysis levels which was found to be significant. They also observed a post-hemodialysis decline of PDW by 11%. It has been shown that a higher value of PDW indicates the presence a higher production of larger reticulated platelets, which have larger and more metabolic activity[19,20]. Thus, PDW can be recognized as a sign of inflammation and coagulation disease. Accordingly, the results show increased PDW in the patients NOT ON HD as compared to the patients ON HD. In a study by Kejriwal et al[21] role of PDW in prognosis of hemorrhagic stroke was studied and it was found that increase in PDW was associated with increase in mortality.

CKD is the gradual and progressive loss of renal function over time amongst the many complications associated with CKD and its consequences, its impact on the platelet function is of significance. It has been observed that the early stages of CKD are typically associated with prothrombotic tendencies while bleeding diathesis are observed in the late stages. This biphasic effect of CKD on thrombosis has been realized since long; however, the exact underlying pathogenic mechanism is yet to be elucidated. Moreover, the data regarding the effect of dialysis on this remains understudied. Therefore, the present study was conducted to evaluate and compare the various platelet indices amongst the CKD and ESRD patients on HD. The present study was conducted on a total of 100 patients (50 each, of CKD (NHD) and ESRD ON HD) after obtaining approval from the Institutional Ethics Committee and written informed consent from the patients. When assessed according to the platelets, it was observed that the PDW, MPV were significantly higher in the NOT ON HD group than the ON HD group

## CONCLUSION AND SUMMARY

It can be concluded from the study that as the serial values of PDW and MPV the chances of CKD (NHD) patients requiring hemodialysis in the future increase.

As these indices are considered as markers of inflammation and CKD is a state of chronic inflammation, therefore, the decreased values of these parameters in patients in the ON HD group indicates a beneficial effect of hemodialysis on the chronic inflammatory state despite the progression of CKD to ESRD. Further studies need to be conducted in this regard to elucidate the exact underlying mechanism.

### Limitations:

The present single center study was limited by the OPD attendance of the patients. Therefore, the results may not be generalized. The study was impacted by the COVID-19 pandemic. The study was conducted in a small population. A much larger study with a larger sample size is needed.

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