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Abstract

Keeping a stable blood pressure (BP) during hemodialysis is one of the important goals for End Stage Renal Disease (ESRD) patients. Maintaining a stable dry weight and controlling cardiovascular risk factors requires well controlled blood pressure with regular measurements. Accurate blood pressure measurement is a key element used during hemodialysis to identify and prevent hypotension with its possible target organ hypoperfusion. Whether there is a difference between using the central or peripheral BP measurements among ESRD patients during hemodialysis is still not clear. To identify the significant difference between the central and peripheral BP we tested the central and peripheral blood pressure in 14 ESRD patients during full dialysis sessions. Over 326 peripheral BP readings were compared with 326 central BP measurements. A significant difference was noticed with a lower central systolic and pulse pressure and a higher central diastolic and Mean arterial pressure (MAP) as compared with the peripheral pressure readings. Since blood pressure measurement is the major factor to determine target organ hypoperfusion during hemodialysis, ignoring the central pressure measurements during hemodialysis could carry the risk of inducing unnoticed target organ hypoperfusion during hemodialysis.

INTRODUCTION

Hypotension is one of the common complications during hemodialysis, specifically among ESRD recently starting renal replacement therapy or those who are hemodynamically unstable. Maintaining a stable blood pressure and preventing hypotension is challenging among these patients [1-4]. Accurate BP measurement is the key factor to avoid and prevent intradialytic hypotension, which is defined as a drop in systolic BP of 20mmHg [1]. We usually rely on measuring the peripheral BP, via the Brachial or Tibial arteries, to determine the target BP and define the cut off for hypotension.

Studies have shown that central aortic pressure is more accurate in predicting target organ damage. It was observed that central aortic pressure holds stronger correlation with other CV risk factors [5,6]. The difference between the central and peripheral BP measurement among ESRD is not studied extensively. We wanted by this study to identify the difference between the central and the peripheral BP measurements during the hemodialysis session.

METHODOLOGY

This study is a prospective, non-Interventional study among adult ESRD patients receiving regular hemodialysis. The patients selected were those chronic on hemodialysis in our unit, hemodynamically stable, using regular medications and on fixed dialysis orders. Patients who were hemodynamically unstable, having Acute Kidney Injury or had recent medication or dialysis orders adjustments, were excluded. The research was approved by the local research committee. Consents were obtained from the patients to measure their blood pressure via a Mobil-O-Graph with a peripheral cuff and analyze the data. The demographic factors were recorded via the electronic files. Central and peripheral BP were repeatedly measured every 30 minutes during 2-3 full hemodialysis sessions for each patient. The validity of the automated non-invasive central pressure measurement was proven in multiple studies [7, 8].

Paired t-test, using SPSS 18 software, was utilized to test the significant difference between the central and the peripheral BP readings for the systolic, diastolic, pulse pressure and the Mean...
Arterial Pressures (MAP). P< 0.01 was required to reject the null hypothesis.

RESULTS

The number of patients included was 14 ESRD patients on regular hemodialysis. During 33 HD sessions, 326 peripheral and 326 central BP measurements were recorded. The mean age was 62.6 years (SD12.9), males constituting 40%. All the patients had hypertension. Thirteen patients were diabetic. Five patients had IHD and 22% of the whole readings were obtained from patients who underwent either PTCA or CABG. The mean systolic, diastolic, pulse pressure, and MAP are shown in Table (1). As noted, there was a significant statistical difference with lower central systolic and pulse pressures, but higher central diastolic and MAP as compared to peripheral measurement.

DISCUSSION

In healthy adults, the central BP was proven to be different from the peripheral measurement. With aging and increased atherosclerosis, the stiff vessels will lose their elastic recoil. This will be manifested in a higher central systolic pressure and lower central diastolic pressure as compared with the peripheral pressure measurements [9]. Studies among CKD patients- have shown that the elasticity of the large arteries starts to decline during early stages of renal impairment. As compared to other patients with normal kidney function, CKD patients have more profuse vascular calcifications with ridged vessels [9]. Due to the loss of the vascular elastic recoil, the pulse wave velocity will increase. The peripheral systolic BP will be higher, but the diastolic BP will be lower as compared to the central measurement [9]. This phenomenon happens with aging, but it is more pronounced among ESRD patients [10-13].

Our aim of this research was to know whether the central BP measurements are different from the peripheral measurements during the hemodialysis with the vascular hemodynamic alterations, and to consider the central measurement in our decision regarding the target BP during HD. When we measure only the peripheral BP and try to challenge the patient’s BP to get to his/her dry weight, we might be causing unnoticed drop in the central pressure that could lead eventually to target organ damage. There was no previous study that tested the difference between the central and peripheral blood pressure during hemodialysis.

This study proves that there was a significant difference between the central and peripheral blood pressure measurements among ESRD patients during the whole hemodialysis session. As elaborated in the result section with Table (1), the central systolic and pulse pressure were significantly lower than the peripheral readings. On the other hand, the central diastolic and MAP were significantly higher than the peripheral blood pressure. This difference was more pronounced among patients with higher cardiovascular risk factors. This raises more the possibility that during hemodialysis treatment monitoring only the peripheral BP, will not be enough to identify and prevent decreased central systolic pressure and target organ perfusion.

In fact, we have noticed in a couple of patients during their regular hemodialysis sessions that they had overt hypotensive symptoms, including; nausea, vomiting, cramps and abdominal pain with a peripheral BP around 140/90mmHg. All their electrolytes were within normal limits. Upon measuring their central aortic pressures, we found that there was a 30mmHg difference between the central and peripheral systolic pressure. When we kept this in mind during successive hemodialysis sessions, their symptoms completely improved. In fact, this observation had triggered the current research work.

It is true to say that until today the kidney is the only organ that can be replaced by a machine for years during the life of the patients with ESRD. However, with all the development and progress, hemodialysis still carries very high unacceptable mortality rates. Could the unnoticed lower central pressure be the reason behind the poor outcome in hemodialysis? Are we inducing central hypoperfusion injury while trying to achieve what is known as the dry weight? These questions will need further studies.

CONCLUSION

When comparing the central and peripheral BP measurements during hemodialysis, there was a significant lower central systolic and pulse with a higher central diastolic and MAP. During hemodialysis, measuring only the peripheral is measured. In fact, this measurement might not be enough to identify hypotension and prevent target organ damage. Adding noninvasive central pressure measurement could reduce the possibility of target organ hypoperfusion. Further studies are required to translate these findings into solid clinical outcomes. Could the high mortality in dialysis be altered by monitoring the central aortic pressure measurements during each HD session? Future research will be required to clarify that aspect.

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Table: Mean systolic, diastolic, Pulse Pressure, and MAP for the central as well as the peripheral BP readings, with the range of difference and the mean difference between central and peripheral readings.

<table>
<thead>
<tr>
<th>Blood Pressure Component</th>
<th>Peripheral (SD)</th>
<th>Central (SD)</th>
<th>Range of Difference</th>
<th>Mean Difference (SD) (Peripheral-Central)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic</td>
<td>157 (30)</td>
<td>140 (28)</td>
<td>61 (-9.52)</td>
<td>16 (10)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Diastolic</td>
<td>80 (19)</td>
<td>83 (18)</td>
<td>38 (-13.25)</td>
<td>-2 (2.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pulse Pressure</td>
<td>78 (24)</td>
<td>57 (24)</td>
<td>78 (-13.65)</td>
<td>18 (11)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Mean Arterial Pressure</td>
<td>105 (20)</td>
<td>108 (21)</td>
<td>38 (-13.25)</td>
<td>-2 (2.7)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

REFERENCES


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