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Original article

PT and PTT; Are They Significant Indicators of Poor Prognosis in Severe Renal Failure Patients?

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Abstract

The coagulation system has gained significant interest in the recent past, especially in patients diagnosed with renal failure, as they are susceptible to significant comorbidity that requires anticoagulation. Research indicates that patients diagnosed with renal failure are at an increased risk of developing complications associated with coagulation abnormalities. Renal failure patients experience excessive bleeding even on new anticoagulants due to pharmacokinetic profile changes of the compounds. However, even without anticoagulants, the coagulation systems in patients with renal failure are profoundly changed, leading to significant morbidity and mortality in such patients. The underlying reasons for such problems involve the changes in the interaction of coagulation system components such as the platelets, coagulation cascade, and the vessel wall in the metabolic conditions of renal pathology. One meaningful way of evaluating the coagulation status of patients diagnosed with renal failure is through prothrombin time (PT) and partial thromboplastin time (PTT) blood tests. The two laboratory tests are used to evaluate coagulation disorders where the PT test measures the time it takes for blood to clot in response to prothrombin, a clotting factor, activation, and the PTT test measures the time it takes for blood to clot in response to clotting factor activation. This study evaluated PT and PTT levels of renal failure patients to determine their relationship with the disease's severity and prognosis. The study was conducted as a collaboration study between PSAU and KELANA Association. Data were collected from 20 samples, and statistical analysis was done using the SPSS software version 2.0. The research findings indicated insignificant statistical differences between PT levels of renal failure patients and controls, while PTT levels in males significantly differed between patients and the controls. The study indicates that PTT levels can be used to indicate coagulation abnormalities in male patients diagnosed with renal failure.

Keywords: ***Renal failure, PT, PTT, prothrombin, partial thromboplastin time, coagulation, anticoagulants.***

Introduction

Renal failure is a life-threatening illness that develops when the kidneys cease functioning correctly [1]. The condition comes in two primary types: acute and chronic. Acute renal failure strikes rapidly and can be brought on by several factors, including a severe infection, a significant injury, or a drug reaction. Chronic renal failure gradually worsens over time and is frequently brought on by diabetes, hypertension, or a family history of the condition [2]. Depending on the condition severity, renal failure has different symptoms. A few typical signs and symptoms are weakness, lack of appetite, nausea, vomiting, and ankle and foot edema [3].

Prothrombin time (PT) is a blood test that determines how long it generally takes for blood to clot. PT is employed to evaluate the body's clotting capacity and thromboplastin, a chemical that aids in the initial stage of the clotting process, is added. The average PT is between 11 and 13 seconds, and when the PT is prolonged, the blood clots more slowly than usual. Further, the partial thromboplastin time (PTT) is another test that determines how long blood can clot. PTT is used to evaluate the body's clotting capacity, calculated by incorporating kaolin into a blood sample [4]. The average PTT time is between 24-35 seconds. Thus, a prolonged PTT indicates the blood clotting process is taking longer than usual [5].

Both PT and PTT can be prolonged in patients with renal failure. This is because the kidneys produce certain clotting factors, such as prothrombin and fibrinogen. A prolonged PT and PTT result from the kidneys' inability to make these clotting factors in sufficient amounts when not working correctly [6]. Further, patients with kidney failure may experience an increased risk of bleeding if their PT and PTT are extended. This is due to the blood's decreased ability to clot, which can induce bleeding from minor injuries or spontaneously. In addition, a prolonged PT and PTT can indicate a poor prognosis in patients with renal failure and raise the risk of bleeding [6]. This is because prolonged PT and PTT may point to kidney illness and increase the likelihood that the patient would die or experience additional complications like heart disease or a stroke.

Several studies looked into the connection between PT and PTT and renal failure. These studies have demonstrated that patients with renal failure are more likely than those with normal kidney function to experience prolonged PT and PTT. In one study, Gäckler et al. (2019) discovered that patients with end-stage renal disease (ESRD) had a statistically significant higher likelihood of more prolonged PT and PTT than those with normal kidney function [7]. The study also discovered that the length of the PT and PTT increased the risk of bleeding. Another study by Diptyanusa et al. (2019) discovered that people with CKD were more likely to have a more prolonged PT and PTT than people with good renal function [8]. The same study also found that as the PT and PTT were extended, the chance of death increased.

This study aims to explore and identify the level of PT and PTT in renal failure patients to determine their association with the severity and prognosis of the disease.

Materials and Methods

Data Sources

This study was conducted as a collaboration project between PSAU and KELANA Association based in Riyadh between Sept 2022- Feb 2023. Data were obtained from the patients' files with the help of Prof. Aldughythair and Dr. Waleed.

Eligibility Criteria

1. All patients are not taking any medication that may affect the PT and/or PTT levels.
2. All patients are in 3 sessions per week.
3. We collected 20 samples and statistics were done later as shown.
4. 90% of the patients were NON-Saudi
5. 15% smokers, 10% high BP, 10% DM, 1% hypothyroidism

Normal PT values: 10-15 seconds
Normal PTT values: 25 to 40 seconds

Statistical analysis

Data were analyzed using the SPSS software version 20. The findings were presented as mean±SD. A p-value of 0.05 or less was considered to be statistically significant

Results

Of the total of 20 patients most of them were females (70%), the rest (30%), being males. The participants were adults aged between 17 to 60 years (table-1). Based on BMI, it was found that 75% of participants had a normal weight, 25% were overweight. Table 2 shows no significant difference in PT levels in both groups. However, there was a trend difference in PTT levels in male RF subjects compared to male controls (p=0.2).

Table 1: Demographic data of patients and controls.

Group	Mean Age	Number
KIDNEY PATIENTS; Male	46	6
KIDNEY PATIENTS; Female	40	14
CONTROL; Male	23	5
CONTROL; Female	47	5

Table 2: Measurement of PT and PTT in both groups

Group	PT	PTT
KIDNEY PATIENTS; Male	13.9±5	23.2±3
KIDNEY PATIENTS; Female	15.1±3	28.2±4
CONTROL; Male	14.6±2	38.1±9
CONTROL; Female	12.3±4	27.2±7

Discussion

Patients diagnosed with renal failure commonly have blood coagulation problems. Thrombotic complications have become the most common causes of mortality and present a challenge during renal therapies among patients with renal diseases [9]. As a result, these patients have increased rates of bleeding which are thought to be driven principally by platelet dysfunction, low production of clotting factors, and anticoagulants with pharmacokinetic profile changes of the compounds that affect blood clotting mechanisms [10]. This study contributes to the existing studies on the relationship between renal failure and coagulation abnormalities and complications by investigating and highlighting PTT levels as a significant indicator of the severity and prognosis of the disease [11-14].

Regarding PT levels, there were no significant statistical differences between renal patients and control samples. The patient and control samples had PT levels within the normal PT values of between 10 and 15 seconds. This finding is consistent with Gäckler et al. (2019), who found that the extrinsic pathway of coagulation as measured by activated prothrombin time was within the normal range in the patients diagnosed with end-stage renal failure [15]. Jain

and Reilly (2019) explains this phenomenon by stating that clotting factors such as factor VII, involved in the extrinsic pathway, are not principally cleared in the renal system [16]. Despite the present study indicating that prothrombin time may not be a significant indicator of coagulation abnormalities in renal failure patients, some studies have indicated that it can be a significant indicator, especially in patients with end-stage chronic kidney disease in the setting of coagulopathy [13]. The difference in the research findings can be explained by the small sample size used in the present study and the deliberate prohibition of patients on treatment plans that may affect the PT levels from the sample study. Research with a more extensive and diverse sample is needed to determine the relationship between renal disease and PT levels.

Regarding PTT levels, the levels in males were significantly different between patients and the controls. In females, there was an insignificant statistical difference between the levels in patients and controls. In all findings, except for renal failure patients, the PTT levels were in the normal range of PTT values; 25 to 40 seconds. The trend difference in PTT levels in male patient subjects compared to male controls indicate that PTT levels can be used to indicate coagulation abnormalities in renal failure patients. This finding is consistent with the previous findings. For instance, Ye et al. (2023) highlights that since the intrinsic coagulation pathway activates factors such as VIII, IX, XI, and XII, which are principally cleared by the renal system, kidney failure prevents this clearance resulting in a hypercoagulable state that results in a low PTT level [14]. A low level means faster coagulation than normal. Also, a study by Pavlou et al. (2021) found that advanced chronic kidney disease patients have significantly lower PTT levels than controls which were inversely correlated to creatinine clearance indicating renal failure contributes to hypercoagulability [17]. The result is an increased risk of bleeding and thrombosis. As such, the study indicates that PTT levels can indicate coagulation abnormalities in male patients diagnosed with renal failure. The study contributes to the existing research on the relationship between renal failure and coagulation abnormalities, indicating the importance of monitoring coagulation parameters during renal therapy. However, this study had a small sample size meaning that the results cannot be generalized; further research is necessary to understand the insights into renal failure and coagulation abnormalities relationship.

Other than a small size that limits the generalizability of the study findings, this study had other limitations that need to be considered. The study did not consider the relationship between prothrombin time and partial thromboplastin time levels and clinical outcomes such as bleeding. Furthermore, this study did not take into account the impact of confounding factors that may affect PT and PTT levels, such as the use of anticoagulants.

Future research is needed to investigate the relationship between coagulation abnormalities and specific renal failure complications. This study and the existing research investigate this relationship in general renal failure. Specific complications such as bleeding complications, thrombotic events, and mortality need to be investigated in terms of their relationships with coagulation abnormalities. This would be important in formulating more effective treatment plans relevant to specific complications associated with renal failure. Additionally, the role and interaction of coagulation factors and their relationship with coagulation abnormalities in renal failure patients need to be further explored to determine the mechanisms of the observed coagulation abnormalities.

Conclusion

This study aimed to investigate the PT and PTT levels and determine whether they can be used as significant indicators of renal failure severity and poor prognosis. The study found that, while there were insignificant statistical differences between PT levels of renal failure patients and controls, there was an observed trend difference in PTT levels in male renal failure patients compared to male controls. The study findings indicate that PTT levels can be significant indicators of severe renal failure and poor prognosis. The study contributes to the existing literature by highlighting how coagulation abnormalities play a significant role in renal pathology.

Conflict of Interest

There was no conflict of interest.

Funding

The entire financial burdens were burn by the researchers.

Data Availability

Data would be available upon reasonable request by corresponding author.

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