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Original Research Article

# Serial Evaluation of Platelet in Grade 3 Thrombocytopenic Dengue Patients Post Single Donor Platelet (SDP) Transfusion at a Tertiary Healthcare Blood Centre

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**Abstract:**

**Background:** Dengue fever, transmitted by Aedes mosquitoes, poses a global health threat, with over 96 million symptomatic cases reported annually. Thrombocytopenia, a common haematological manifestation in dengue, can lead to severe complications. Grade 3 thrombocytopenia, with platelet counts below 50,000/mm³, signifies disease severity, warranting prompt intervention. While platelet transfusion is crucial, concerns with Random Donor Platelets (RDP) prompt exploration of Single Donor Platelets (SDP). This study aims to elucidate post-SDP transfusion platelet recovery dynamics in Grade 3 thrombocytopenic dengue patients.

**Methods:** This prospective observational study spanned 5 months at a Tertiary Healthcare Centre in Eastern Uttar Pradesh, India, from August to December 2023. Patients aged ≥18 years with severe dengue and Grade 3 thrombocytopenia (<50,000/mm³) were recruited. Single Donor Platelet (SDP) was prepared using TRIMA ACCEL Automated Blood Collection System. Platelet counts were analyzed with the BC 6200 Auto haematology Analyzer. Data were recorded on MS Excel and analyzed using SPSS version 20.0.

**Results:** A total of 73 Single Donor Platelet (SDP) transfusions were performed in 2023 at our centre, for Dengue patients. Notably, among Dengue patients from August to December 2023, 7 individuals required 2 SDP transfusions each, while 2 Dengue patients required 3 SDP transfusions each. The mean SDP yield ranged from 3.1 $x10^{11}$ to 6.0 $x10^{11}$, averaging 4.1 ± 0.7 $x10^{11}$. Demographic distribution showed 29 males (39.7%) and 44 females (60.3%), with a mean age of 39.6 ± 15.4 years. Platelet counts significantly increased post-transfusion: Pretransfusion (19.2 ± 6.6 x $10^3$ per cumm), Day 1 (50.7 ± 20.2 x $10^3$ per cumm), Day 2 (75.8 ± 27.8 x $10^3$ per cumm), and Day 3 (106.6 ± 29.4 x $10^3$ per cumm) (df=3, F=187.321, p=0.000).

**Conclusion:** In conclusion, the findings of this study underscore the efficacy and safety of SDP transfusion in Grade 3 thrombocytopenic dengue patients, offering a promising therapeutic approach for mitigating bleeding risks and improving patient outcomes.

**Keywords**: Dengue, Platelets, SDP, Transfusion, Thrombocytopenia.



## Introduction

Dengue fever, caused by the four serotypes of the dengue virus transmitted by Aedes mosquitoes, continues to impose a significant burden on global public health [1]. The World Health Organization estimates that over 3.9 billion people in more than 128 countries are at risk of dengue infection, with approximately 96 million symptomatic cases reported annually [2]. While the majority of dengue cases manifest as a self-limiting febrile illness, a subset progresses to severe forms, including Dengue Haemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS), marked by vascular leakage, severe organ involvement, and an increased risk of mortality [3].

Thrombocytopenia is a consistent and critical haematological manifestation observed in dengue infection, often preceding the onset of severe clinical symptoms [4]. Platelets play a pivotal role in the maintenance of vascular integrity, and their depletion contributes to the pathogenesis of bleeding complications, a hallmark of severe dengue cases. Grade 3 thrombocytopenia, characterized by a platelet count falling below 50,000/mm³, signals a pivotal juncture in disease progression, necessitating vigilant and tailored therapeutic interventions [5,6,7]. Platelet transfusion remains a cornerstone in the clinical management of severe thrombocytopenia associated with dengue infection

[8]. The traditional approach utilizing Random Donor Platelets (RDP) has been met with challenges, including the risk of alloimmunization and variability in platelet dose [9]. In response to these concerns, Single Donor Platelets (SDP) have emerged as an attractive alternative, offering a more standardized and concentrated platelet dose, potentially minimizing transfusion-related complications [9].

Despite the increasing adoption of SDP transfusions in the management of severe thrombocytopenia in dengue patients, a comprehensive understanding of the serial changes in platelet counts and associated clinical outcomes is notably lacking [10,11]. So, the present study was conducted to explore the platelet recovery dynamics post-SDP transfusion in Grade 3 thrombocytopenic dengue patients.

## Materials and Methods

### Study Design

This prospective observational study was conducted under the Department of Pathology at Tertiary Healthcare Blood Centre in eastern Uttar Pradesh India of spanning a duration of 5 months from August 2023 to December 2023. Ethical approval for the research was obtained from the Institutional Review Board (IRB) of the Institution. All participants provided informed consent before inclusion in the study.

### Participants

Patients (18 years or more) diagnosed with severe dengue and Grade 3 thrombocytopenia (platelet count < 50,000/mm$^3$) were recruited from critical care unit, intensive care unit and general medicine ward of Tertiary Healthcare centre. Inclusion criteria encompassed confirmed dengue infection through laboratory tests (NS1 antigen, IgM) and the presence of Grade 3 thrombocytopenia at the time of enrolment. Exclusion criteria included contraindications to platelet transfusion, known platelet disorders, and pregnancy.

### Intervention

All eligible participants underwent Single Donor Platelet (SDP) transfusion as a therapeutic intervention for severe thrombocytopenia associated with dengue infection. The SDPs were prepared from a meticulously screened pool of voluntary donors, ensuring compliance with strict selection criteria, including absence of infectious diseases, recent travel to endemic regions, and adherence to blood donation eligibility guidelines. The Single Donor Platelet (SDP) preparation in this study utilized the TRIMA ACCEL Automated Blood Collection System, manufactured by Terumo Penpol, and Platelet counting in this study was performed using the BC 6200 Auto haematology Analyzer, a sophisticated instrument manufactured by Mindray.

The transfusion protocol adhered to institutional guidelines, considering the severity of thrombocytopenia and the clinical condition of the individual patient. Platelet transfusion doses were determined based on a permissive threshold strategy, balancing the need for maintaining adequate platelet counts with the potential risks associated with transfusion. The administration of SDP was conducted by experienced healthcare professionals following established protocols, with due consideration to the rate of transfusion and monitoring for any adverse reactions.

The timing and frequency of SDP transfusions were individualized based on the patient's clinical response, with a particular emphasis on achieving and sustaining an optimal platelet count to minimize the risk of bleeding complications. The entire transfusion process, from donor screening to the administration of SDPs, adhered to stringent quality control measures and standard operating procedures. Throughout the intervention, close clinical monitoring was implemented to assess the efficacy and safety of SDP transfusions. Parameters such as vital signs, bleeding manifestations, and other transfusion-related complications were meticulously documented. Any adverse events or transfusion reactions were promptly addressed, and necessary interventions were initiated in collaboration with the multidisciplinary healthcare team.

### Data Collection

Baseline demographic data, clinical characteristics, and laboratory parameters were recorded at the time of admission. Serial platelet counts were obtained at predefined intervals post-SDP transfusion (e.g., 24 hours, 48 hours, and 72 hours). Clinical outcomes, including bleeding manifestations, transfusion reactions, and other relevant complications, were documented during the study period.

### Laboratory Analysis

Platelet counts were determined using BC 6200 Auto haematology Analyzer, Mindray. Additional laboratory investigations included haematocrit, white blood cell count, liver function tests, and coagulation profile. Dengue serological tests were performed to confirm the diagnosis.

### Statistical Analysis

Data were recorded on MS excel sheet and analyzed using SPSS version 20.0.Descriptive statistics were employed to summarize baseline characteristics, and continuous variables were expressed as mean ± standard deviation.

Changes in platelet counts over time were assessed using repeated measures ANOVA. Clinical

outcomes were analyzed using appropriate statistical tests, and p-values < 0.05 were considered statistically significant.

**Ethical Considerations**

The study was conducted in adherence to the principles of the Declaration of Helsinki and Good Clinical Practice guidelines. Confidentiality and privacy of participants were strictly maintained throughout the study.

**Results**

In our centre a total of 107 Single Donor Platelet (SDP) transfusions were conducted throughout the year 2023. The distribution of SDP transfusions during the study period varied across different medical conditions, with 2 for surgical cases, 1 for Acute Subdural Haemorrhage (SDH), 1 for Pancytopenia, 30 for Thrombocytopenia, and a predominant 73 transfusions for Dengue patients. Notably, within the subset of Dengue patients from August to December 2023, 7 individuals required 2 SDP transfusions each, while 2 Dengue patients required 3 SDP transfusions each. In our study Single Donor Platelet (SDP) yield, ranged from a minimum of 3.1 $x10^{11}$to a maximum of 6.0 $x10^{11}$, with an average yield of 4.1 ± 0.7$x10^{11}$.

The distribution of demographic variables among the study participants is summarized in Table 1. Among the participants, 29 individuals (39.7%) were male, while 44 individuals (60.3%) were female. The mean age of the participants was calculated to be 39.6 years, with a standard deviation of 15.4 years.

**Table 1: Baseline distribution of the patients (N=73)**

| Variables | Frequency | % |
|---|---|---|
| **Gender** | | |
| **Male** | 29 | 39.7 |
| **Female** | 44 | 60.3 |
| **Mean age (in years)** | 39.6±15.4 | |

The mean platelet count prior to transfusion (Pretransfusion) was 19.2 ± 6.6 x $10^3$ per cumm, exhibiting a significant increase on Day 1 (50.7 ± 20.2 x $10^3$ per cumm), Day 2 (75.8 ± 27.8 x $10^3$ per cumm), and Day 3 (106.6 ± 29.4 x $10^3$ per cumm) post-transfusion. The observed changes in platelet counts at each time point were statistically significant (df=3, F=187.321, p=0.000) (Table 2 and Figure 1).

**Table 2: Comparison of platelet counts pre transfusion and post transfusion among patients**

| Time | Platelet count (x$10^3$ per cumm) | | | | | |
|---|---|---|---|---|---|---|
| | Mean±SD | SE | 95% CI limit | | Minimum | Maximum |
| | | | Lower | Upper | | |
| Pretransfusion | 19.2±6.6 | 0.8 | 17.6 | 20.7 | 8.0 | 40.0 |
| Day 1 | 50.7±20.2 | 2.4 | 46.0 | 55.4 | 15.0 | 120.0 |
| Day 2 | 75.8±27.8 | 3.4 | 69.1 | 82.5 | 19.0 | 140.0 |
| Day 3 | 106.6±29.4 | 3.6 | 99.3 | 113.9 | 25.0 | 171.0 |
| df=3, F=187.321, p =0.000 | | | | | | |

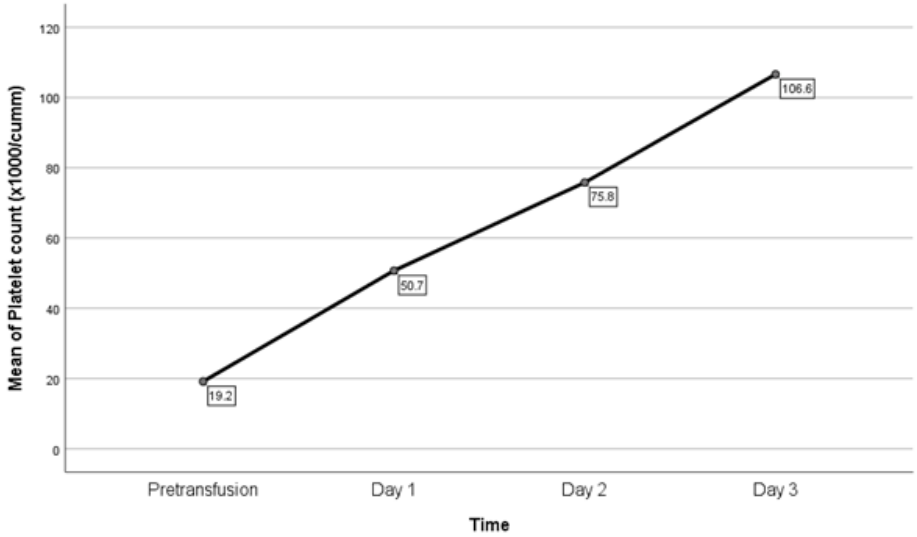


**Figure 1: Comparison of platelet counts pretransfusion and posttransfusion among patients**

## Discussion

The findings of this study provide valuable insights into the efficacy and clinical implications of Single Donor Platelet (SDP) transfusion in Grade 3 thrombocytopenic dengue patients. The discussion will explore the key observations, their implications, and potential avenues for further research.

In our study, the mean age of the participants was 39.6 ± 15.4 years, which was similar to the studies by Pervin et al., Shivbalan et al., and Chairulfatah et al, [12,13,14].

The substantial increase in platelet counts observed post-SDP transfusion underscores the therapeutic efficacy of this intervention in addressing severe thrombocytopenia associated with dengue infection. The mean platelet count surged from pretransfusion levels of 19.2 ± 6.6 x $10^3$ per cumm to 106.6 ± 29.4 x $10^3$ per cumm by Day 3, indicating a robust and sustained platelet recovery. This notable improvement in platelet counts aligns with previous studies by Kulkarni et al., Slichter et al., Kansay et al., and Machakanur et al., highlighting the effectiveness of SDP transfusions in augmenting platelet levels and mitigating bleeding risks in dengue patients [15,16,17,18].

The serial evaluation of platelet counts post-transfusion provides valuable insights into the dynamics of platelet recovery over time. The observed increase in platelet counts from Day 1 to Day 3 post-transfusion suggests a gradual but steady rise in platelet production and circulation, reflecting the biological response to SDP infusion. Such temporal trends in platelet recovery offer clinicians a valuable tool for monitoring patient progress and tailoring therapeutic interventions accordingly [19,20,21].

The observed variability in platelet counts among individual patients underscores the importance of personalized treatment strategies in managing severe thrombocytopenia. Factors such as disease severity, baseline platelet count, and patient-specific characteristics may influence the magnitude and kinetics of platelet recovery post-transfusion [22,23,24]. Hence, a tailored approach to SDP transfusion, guided by patient-specific factors and clinical parameters, is essential for optimizing therapeutic outcomes and minimizing the risk of adverse events [25,26,27]. While SDP transfusion emerges as a cornerstone in the management of severe thrombocytopenia in dengue patients, several considerations warrant further exploration. Future research endeavours should focus on elucidating the optimal timing, dose, and frequency of SDP transfusions, with an emphasis on balancing the need for rapid platelet recovery with the risk of transfusion-related complications [28]. However, there was suboptimal increase in post transfusion platelet count due to concurrent ongoing platelet destruction in few of the dengue cases. Additionally, prospective studies evaluating the impact of SDP transfusions on clinical outcomes, such as bleeding manifestations, length of hospital stay, and mortality rates, are warranted to further validate the therapeutic benefits of this intervention.

## Limitations

Few limitations should be acknowledged in interpreting the findings of this study. Firstly, the study was conducted at a single tertiary healthcare blood centre, which may limit the generalizability of the results to other settings. Additionally, the sample size of Grade 3 thrombocytopenic dengue patients undergoing Single Donor Platelet (SDP) transfusion was relatively small, potentially impacting the statistical power and precision of the observed outcomes. The lack of a control group and randomization in the study design also precludes the establishment of causal relationships and comparison with alternative treatment modalities. Moreover, the study focused primarily on platelet count as the primary outcome measure, without considering other relevant clinical parameters or long-term follow-up data. Finally, while efforts were made to standardize transfusion protocols and adhere to institutional guidelines, variations in clinical practices and patient management among healthcare providers may have influenced the observed outcomes.

## Conclusion

In conclusion, the findings of this study underscore the efficacy and safety of SDP transfusion in Grade 3 thrombocytopenic dengue patients, offering a promising therapeutic approach for mitigating bleeding risks and improving patient outcomes.

Moving forward, a concerted effort to refine transfusion protocols, enhance patient selection criteria, and elucidate the mechanistic underpinnings of platelet recovery post-transfusion will be crucial for advancing the field of transfusion medicine and optimizing the management of severe thrombocytopenia in dengue fever.

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