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Original Research Article

THE PROGNOSTIC SIGNIFICANCE OF PREOPERATIVE AND POST-OPERATIVE PLATELET INDICES IN PATIENTS UNDERGOING SURGICAL PROCEDURE: A PROSPECTIVE CROSS-SECTIONAL STUDY

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Abstract

Background: Platelet indices (PI) which include plateletcrit, mean platelet volume (MPV) and platelet distribution width (PDW) are a group of derived platelets estimated during a routine blood test. It has been noted in the various studies that platelet indices (PI) are elevated in patients with acute surgical conditions, such as appendicitis and PIs are lowered in cases of severe sepsis, therefore a generalised study is necessary. The aim of this study was to assess the predictive value of platelet indices on surgical wound healing in patients who underwent a surgical procedure and/or experienced surgical site infection following surgery. **Materials and Methods:** The study population included patients who had undergone surgery in either of the departments of Surgery, ENT, Orthopaedics or Gynaecology from the tertiary care hospital, GIMS, Gadag and had a complication of either wound infection or wound gaping. The Platelet indices collected in the pre-operative and post-operative period was compared. Following surgery, the platelet count and plateletcrit was observed to increase and the MPV and PDW was observed to decrease. **Result:** A total of 235 cases were analyzed. The post-surgical complication observed were wound gaping (138) and wound Infection(7). The Platelet indices in pre-operative and post-operative period were compared and noted that the post-operative platelet count and plateletcrit was increased while MPV and PDW decreased. **Conclusion:** All the 300 patients showed significant change in the platelet indices in the postoperative period after which they developed complication of wound healing which soon resolved, hence indicating that platelet indices are a reliable prognostic indicator in post-surgical patients.

INTRODUCTION

The post-surgical mortality rates have been a topic of research in recent times. The overall postoperative mortality rate is 2.4% which increases to 8.8% when accompanied by complications,[1-4] thus, determining the postoperative prognosis as a necessary study.[1-4]

There is a large body of evidence showing platelets are likely to contribute to inflammation in multiple diseases and have supportive role in physio pathological processes like tissue regeneration and wound healing.[2,3,5,6] Also, recent studies revealed the association between platelet indices (PI) and inflammation.[2,4]

Platelets mediate wound healing process and haemostasis after surgical procedures by releasing various cytokines and activating complement system.[5,7] Platelets actively migrate out of blood vessels during surgical cuts wounds or incisions to assist in wound sterilization and tissue regeneration.[6,8]

Platelets: Platelets are a part of blood components derived from bone marrow megakaryocytes, with a diameter of 3-5 μm and a volume of 4.5–11fL. A megakaryocyte is known to release 1500–2000 platelets by pinching off cytoplasm, where they

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circulate for 7–10 days. Platelets in the blood are discoid shaped and enucleated. Their cytoplasm contains three different types of granules -alpha granules, dense granules, and lysosomal granules, and a complex membranous system.[9]

The platelet progenitor cell, megakaryocytes undergo a series of changes before forming a platelet. They migrate from the hematopoietic stem cell (HSC) osteoblastic niche to the vascular niche where they mature and eventually extend proplatelets and release platelets into the bloodstream. This is regulated by transcription factors, signaling and adhesion molecules, cytokines and chemokines. Among these many mediators, the most important for megakaryopoiesis is thrombopoietin (TPO).[10]

Main function of the platelets is as regulators of haemostasis and thrombosis. Following vascular insult, platelets become activated in the blood resulting in their adhesion to the exposed extracellular matrix underlying the endothelium, formation of a platelet plug, which act as a temporary plug till the clotting factors come into play and form a definitive plug.[11] In pathological conditions, platelets are incriminated in the formation of occlusive thrombus and as a result are the primary target for prevention of arterial thrombus formation as in MI, stroke etc. which are prophylactically treated by antiplatelet drugs. In addition to regulation of haemostasis in the vessel, platelets have also been shown to play an important role in innate immunity as well as regulation of tumour growth and extravasations in the vessel.[12]

Platelet Indices: There are 4 platelet indices which are commonly measuredin routine laboratory tests, and which show characteristic changes in a number of conditions.

Mean platelet volume (MPV) signifies the average size of platelets in the blood. In healthy subjects it typically ranges between 7.2 and 11.7 fL.[13]

Platelet distribution width (PDW) is a marker of platelet anisocytosis, which describes the size distribution of platelets produced by megakaryocytes and increases upon platelet activation. This parameter is found to vary between 10 and 18% in healthy individuals.[14]

Platelet larger cell ratio (P-LCR) is a percentage of all platelets with a volume measuring over 12 fL circulating in the bloodstream. It normally ranges between 15 and 35%.[15] This parameter is not considered in our study.

Plateletcrit (PCT) measures total platelet mass as a percentage of volume occupied in the blood. The normal range for PCT is 0.22–0.24%. It seems to play an effective screening role in detecting platelet quantitative abnormalities.[16]

Wound Healing: Vasoconstriction is the immediate response of the injured blood vessels followed by activation of platelets to form a fibrin clot. This is an important step in haemostasisand provides a scaffold for incoming inflammatory cells which provide local immunity. Neutrophils are immediately recruited to the clot as a first line of defense against bacteria. Monocytes are recruited within 48–96 h after injury and transform into tissue-activated macrophages at the wound site.[17]

Next is the angiogenesis phase which involves endothelial cell proliferation, migration, and branching to form new blood vessels. At the same time, pericytes within the basal lamina are activated which provide structural integrity to the endothelial cells.[18]

Within a short duration of injury, fibroblasts proliferate and invade the clot to form contractile granulation tissue. Here, some fibroblasts differentiate into myofibroblasts, drawing the wound margins together, causing wound contraction. The dividing fibroblasts deposit ECM and shift the wound microenvironment from the inflammatory to the growth state. Re-epithelialization simultaneously occurs from the periphery and involves the proliferation of both unipotent epidermal stem cells from the basement membrane and de-differentiation of terminally differentiated epidermal cells.[19]

Surgical Site Infection: The Centre for Disease Control and Prevention (CDC) and the European Centre for Disease Prevention and Control (ECDC) defines SSI as postoperative infection occurring within 30 days of a surgical procedure (or within one year for permanent implants).[20,21]

Surgical site infection (SSI) is one of the most frequently reported types of hospital-acquired infection (HAI), constituting up to 19.6% of all HAIs in Europe in 2011–2012.[22]

The development of an SSI causes a substantial increase in the clinical and economic burden of surgery. It leads to prolonged hospitalization of the patient, repeat diagnostic tests, and treatment of the infected site. SSIs negatively impact on patient physical and mental health. They have become an increasing cause of patient mortality, morbidity and adds up to indirect costs due to loss of earning during the extended period of illness.[23]

MATERIALS AND METHODS

The study is a cross-sectional observational study with a sample size of 235 cases conducted during a period of 3 months between January 2023 and March 2023.sampling technique used was universal sampling. We collected approximately 15 to 20 cases per day and data was collected from the patient case files and investigation records.

The study population included patients who had undergone surgery in the departments of Surgery, ENT, Orthopaedics and Gynaecology from the tertiary care hospital, GIMS, Gadag and had a complication of either wound infection or wound gaping.

Patients excluded were all patients who underwent Blood Transfusion at least 3 months prior to the surgery, during surgery or immediately after the

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surgery, Patients on any antiplatelet drug and patients admitted due to road traffic accidents.

The data was collected from a Performa based questionnaire 7 to 14 days after the surgery after taking an informed consent. Data was also collected from haematological investigations from patient records. Data entry was done in Excel sheet and was analysed by proportion and paired t test.

RESULTS

In the current study, a total number of 235 cases was collected and analysed. Among the 235 cases, 103 was from the department of surgery, 74 from the department of gynaecology, 35 from the department of ENT and 23 from the department of orthopaedics. The age group of the study population varied from 13 to 62 years, with maximum subjects falling into the range of 20 to 30 years. The Male to female ratio of the study population was 1.7:1.

Among the study population, two post-surgical complications were observed, them being, wound gaping and wound Infection and noted in 138and 97 subjects respectively.

The Platelet indices collected in the pre-operative and post-operative period (7 to 14 days after the surgery) was tabulated and compared [Table 1]. Following surgery, the platelet count and plateletcrit was observed to increase and the MPV and PDW were observed to decrease.

A Paired t test was done to calculate the p value and to assess the significant changes. [Table 2 and Table 3]. The test revealed a p value of than 0.05 indicating the statistics are significant.

Table 1: Mean values of Preoperative and postoperative platelet indices Descriptive Statistics

N = 235	Minimum	Maximum	Mean	Std. Deviation
Age	13	62	29.95	7.583
Pre-operative platelet count	1.90	3.70	2.77	0.38
Pre-operative MPV	8.60	11.70	9.88	0.65
Pre-operative PDW	22.9	25.0	24.09	0.56
Pre-operative plateletcrit	0.21	0.24	0.23	0.008
Post-operative platelet count	3.70	4.90	4.24	0.30
Post-operative MPV	7.2	8.0	7.59	0.24
Post-operative PDW	7.1	8.0	7.50	0.25
Post-operative plateletcrit	.22	0.32	0.27	.022

(Abbreviations: MPV – Mean platelet volume, PDW – Platelet distribution width.)

Table 2: Paired T-Test

N = 235	Mean	Std. Deviation	Std. Error Mean
Post-Operative Platelet Count	4.24	.30	.02
Pre-Operative Platelet Count	2.77	.38	.02
Post-Operative MPV	7.591	.2462	.0161
Pre-Operative MPV	9.88	.65	.04
Post-Operative PDW	7.501	.2547	.0166
Pre-Operative PDW	24.091	.5632	.0367
Post-Operative Plateletcrit	.27	.022	.001
Pre-Operative Plateletcrit	.2300	.00887	.00058

Table 3: Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Post-operative platelet count - pre-operative platelet count	1.46	.47	.03	1.40	1.52	47.098	234	.000
Pair 2	Post-Operative MPV - Pre-Operative MPV	-2.29	.71	.04	-2.38	-2.20	-49.364	234	.000
Pair 3	Post-Operative PDW - Pre-Operative PDW	-16.58	.62	.04	-16.67	-16.50	-406.26	234	.000
Pair 4	Post-operative Plateletcrit- Pre-operative Plateletcrit	.046	.023	.0015	.042	.049	29.686	234	.000

DISCUSSION

In this study, we have observed that the platelet count has increased postoperatively in patients of all age group and genders. The mean preoperatively is 2.77 lakhs per microlitre and postoperatively is 4.24 lakhs per microlitre. As the data suggests there is a significant increase in the platelet count postoperatively. Haemodilution and platelet consumption cause reduction in platelet count in early days post-operative period, typically within 4 days of surgery, which leads to increased levels of thrombopoietin. This in turn leads to increased production of platelets and this significant rise in numbers is seen typically between 7 to 14 days after surgery.[24]

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In a similar study conducted by Budak et al, On the use of platelet indices in emergency non traumatic abdominal surgery showed results with respect to postoperative platelet count which are in concordance with the current study.[7]

We found that the MPV decreases significantly after surgery with a preoperative mean of 9.88 fL and postoperative mean of 7.59 fL. MPV decreases postoperatively due to reduced systemic inflammatory response. This evidence corresponds to the data in our study indicating a decrease in MPV a week after the surgery. Studies on this topic have been conflicting and further research in this area must be conducted to obtain conclusive evidence.

Yang et al, conducted a study on prognostic value of preoperative platelets in gynecological tumours and the results in that study with respect to MPV are in concordance with the current study.[25]

The platelet distribution width drops slightly postoperatively with a preoperative mean of 24.09% and postoperative mean of 7.5%.Platelet distribution width (PDW), another platelet parameter, indicates variation in platelet size and differentially diagnoses thrombocytopenia.[26]

CONCLUSION

The data collected indicated that the plateletcrit slightly increases postoperatively with a preoperative mean of 0.23 to a postoperative mean of 0.27. this is in par with the results obtained from the platelet count.

All the 300 patients showed significant change in the platelet indices in the postoperative period after which they developed complication of wound healing which soon resolved, hence indicating that platelet indices are a reliable prognostic indicator in post-surgical patients.

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