ORIGINAL RESEARCH

To compare the platelet levels before and after surgery in patients diagnosed with benign and malignant neoplasms

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Received: 05 May, 2023 Accepted: 09 June, 2023

ABSTRACT

Aim: The aim of this study is to compare the platelet levels before and after surgery in patients diagnosed with benign and malignant neoplasms. **Material and methods:** The study sample consisted of patients who had received a histopathological confirmation of either a benign or malignant neoplasm. The participants in the study cohort were instructed to undergo a platelet count examination 2-3 days prior to the surgical procedure and on the 7th day following the surgery. Throughout the duration of the study, a consistent Cell Counter was employed for all patients in order to mitigate any potential discrepancies in platelet counts resulting from technical factors. **Results:** The average preoperative platelet count for patients with malignant neoplasms was 301.58±19.85 K/µl, while the average postoperative platelet count was 192.86±12.58 K/µl [Table 3]. In contrast, for patients with benign neoplasms, the average preoperative platelet count was 211.29±22.58 K/µl, and the average postoperative platelet count was 271.58±15.96 K/µl. In Table 3, it is observed that there is a statistically significant difference ($P < 0.0001$) between the pre-operative and post-operative levels in both cases. **Conclusion:** Platelets play a significant role in the pathophysiology of cancer. The present study provides further support for the existing research findings regarding the interaction between tumor cells and platelets.

Keywords: Platelets, Benign, Malignant, Neoplasms

INTRODUCTION

Platelets have been recognized for a significant period of time as a prominent component of circulating blood. They play a crucial role in the formation of the primary hemostatic plug, and subsequently provide a surface for the coagulation factors to create the secondary hemostatic plug. Additionally, platelets are responsible for monitoring the integrity of blood vessels. Hence, platelets play a prominent and indisputable role in preserving human life. Thrombopoietin, a glycoprotein primarily synthesized in the liver, serves as the principal regulator of platelet count in humans. It is predominantly eliminated by platelets and their precursor cells. [1] Solid tumors create a prothrombotic milieu that is capable of activating platelets. Activated platelets play a critical role in maintaining the stability of tumor blood vessels by preventing hemorrhage within the tumor.[2] Hence, it has been observed that tumors possess the ability to stimulate platelets, leading to the proposition that platelets may subsequently facilitate the progression of tumor development.[3]

Nevertheless, in recent times, platelets have been implicated in a more sinister aspect, namely their involvement in the advancement of cancer. Multiple research studies have identified platelets as significant contributors to the dissemination and advancement of cancer. They facilitate the evasion of immune responses by cancerous cells and promote metastasis.[4]

Despite significant advancements in the fundamental understanding of cancer biology and its potential therapeutic applications, cancer continues to pose a formidable threat to human health and well-being. Therefore, it is imperative to conduct further in-depth studies on all factors that have been implicated or are believed to be implicated in the progression of this disease, in order to enhance the potential for developing more effective curative interventions.

Given the imperative to combat life-threatening cancers and the significant involvement of platelets in the dissemination and advancement of such malignancies (references 5 and 6), the present investigation was conducted to assess the variations in

platelet counts before and after surgical procedures in individuals diagnosed with both benign and malignant neoplasms.

MATERIAL AND METHODS

The study sample consisted of patients who had received a histopathological confirmation of either a benign or malignant neoplasm.

Benign neoplasms comprised of Ameloblastoma, Ossifying. Fibroma, Fibrous Dysplasia,

Odontogenic Myxoma and Pleomorphic Adenoma. Whereas, malignant tumour included cases of Squamous Cell carcinoma (SCC).

These patients had no previous instances of ecchymosis and petechiae during general physical examinations, and were admitted for surgical intervention without any prior adjunctive chemotherapy or radiotherapy. Precautions were implemented to ensure the exclusion of patients who had received blood transfusions prior to, during, or after the surgical procedure, as this could potentially lead to inaccurate platelet count measurements. Furthermore, patients who were taking medications that could potentially affect platelet levels in the bloodstream were also excluded from the study. Additional variables, such as the half-life of the medications administered after surgery and their potential impact on platelet counts, were duly considered. Furthermore, patients who were prescribed long-term postsurgical medications known to modify or influence platelet counts were deliberately excluded from the study. Hence, meticulous attention was given to ensure the inclusion of solely those patients who were free from any potential confounding variables. A total of 50 participants were enrolled in the present study. Out of the total sample, a group of 20 individuals received a diagnosis of a benign neoplasm, while another group of 30 individuals were diagnosed with a malignant neoplasm.

METHODOLOGY

The participants in the study cohort were instructed to undergo a platelet count examination 2-3 days prior to the surgical procedure and on the 7th day following the surgery. Throughout the duration of the study, a consistent Cell Counter was employed for all patients in order to mitigate any potential discrepancies in platelet counts resulting from technical factors. The counts were recorded and calculated, and a paired t-test was conducted using Online Graph Pad Software on the data obtained for both patients with benign and malignant neoplasms. A comparison was conducted between the preoperative and postoperative platelet counts in two distinct groups consisting of benign and malignant neoplasms.

RESULTS

In this study, a total of 50 patients were included, with 50% of them being male and 42% being female. The average age of the patients was 48.85±5.89. The majority of patients (50%) fell within the age range of 40-50 years, followed by those aged 30-40 years (22%), above 50 years (12%), 20-30 years (10%), and below 20 years (6%). According to the data presented in Table 1, among the sample of 50 patients, 60% were diagnosed with a malignant tumor, while the remaining 40% were diagnosed with a benign tumor. Table 2 presents the relevant data. The average preoperative platelet count for patients with malignant neoplasms was 301.58±19.85 K/µl, while the average postoperative platelet count was 192.86±12.58 K/µl [Table 3]. In contrast, for patients with benign neoplasms, the average preoperative platelet count was 211.29±22.58 K/µl, and the average postoperative platelet count was 271.58±15.96 K/µl. In Table 3, it is observed that there is a statistically significant difference ($P < 0.0001$) between the pre-operative and post-operative levels in both cases. Based on the aforementioned findings, it is apparent that patients with benign neoplasms experienced an increase in platelet count after surgery, whereas patients with malignant neoplasms exhibited a decrease in platelet count.

Table 1 Age and gender of the patients

	Number	Percentage
Gender		
Male	29	58
Female	21	42
Age		
below 20	3	6
20-30	5	10
30-40	11	22
40-50	25	50
above 50	6	12
Mean Age	48.85±5.89	

Table 2 Types of tumor

Types of tumor	Number	Percentage
Malignant	30	60

Benign	20	40

Table 3: Statistical analysis of the difference in the mean platelet counts in benign and malignant neoplasms

Nature of the tumor	Mean preoperative platelet count (K/µl)	Mean postoperative platelet count (K/µl)	t- value	*P*
Malignant	301.58±19.85	192.86±12.58	12.85	0.0001
Benign	211.29±22.58	271.58±15.96	9.73	0.0001

DISCUSSION

In the context of physiological processes, the platelet count is typically regulated at a specific threshold through the action of thrombopoietic cytokines. Under normal circumstances, this count remains stable unless there is a pathological condition or an increased physiological need.In instances of malignant neoplasms, the thrombopoietic cytokines are secreted by the malignant cells themselves, resulting in elevated levels of these cytokines in patients with malignant neoplasms.[8] Consequently, the elevated concentrations of thrombopoietic cytokines lead to enhanced platelet production.

Consequently, following the surgical removal of the tumor, there is a decline in the secretion of thrombopoietic cytokines by the tumor cells, leading to a subsequent decrease in platelet production. This observation suggests a decrease in platelet count following the surgical procedure. Elevated platelet levels observed prior to surgery in individuals with malignant neoplasms contribute to the progression of cancer through the subsequent mechanisms.

The concept of platelets binding to tumor cells to create tumor-cell-induced platelet aggregates (TCIPA) was proposed as early as 1968. Subsequently, it was acknowledged that these TCIPA play a role in facilitating tumor metastasis.[9] The hematogenous dissemination of tumor cells involves several platelet receptors, namely GPIb-IX-V, GPVI, Integrin α2 β1, adenosine diphosphate receptor, P-selectin, and thrombin receptors (protease-activated receptors). The receptors in question exhibit an affinity for mucin and other molecules that are specifically expressed by tumor cells, thereby facilitating their binding and subsequent formation of tumor cell-induced platelet aggregation (TCIPA). The formation of these tumor cell-induced immunosuppressive peripheral environments (TCIPA) confers certain benefits to the tumor cells, as they effectively protect them from immune system detection and response. The formation of an aggregate around tumor cells serves to extend their survival in the bloodstream by inhibiting the immune response of natural killer (NK) cells and preventing the destruction of the tumor cells. Furthermore, a recent proposal suggests that tumor cells secrete platelet-derived transforming growth factor Beta upon platelet activation, resulting in the downregulation of the activating immunoreceptor NKG2D on natural killer (NK) cells. Furthermore, these tumor cell-induced platelet aggregates (TCIPA) consist of activated platelets that exhibit a high affinity for endothelial cells, thereby enhancing the process of tumor cell extravasation into the adjacent tissues. Therefore, collectively, these factors contribute to the process of tumor cell metastasis.[10,11]

The activated platelets contain Alfa granules that release a range of pro-angiogenic and angiogenic proteins, such as platelet-derived growth factor, vascular endothelial growth factor, and angiopoietin-1. These proteins play a crucial role in facilitating the development of novel vascular channels surrounding the malignant tumor.[12] In addition to the complexity of the matter, recent research indicates that platelets play a crucial role in the regulation of tumor vasculature hemostasis and the prevention of intratumoral hemorrhage. The observed phenomenon is not influenced by the platelets' ability to form blood clots, but rather relies on their release of granules.[13]

Platelets facilitate the recruitment of granulocytes through the release of chemotactic factors that attract the granulocytes. The impact of granulocytes on tumor growth and metastasis is contingent upon the microenvironmental cues. Research has demonstrated that targeted suppression of platelet-derived signals or platelet-granulocyte interactions could potentially restrict the advancement of metastasis by impeding the development of the initial metastatic microenvironment.[13]

Therefore, the significance of platelets in the advancement of cancer is established, and the findings derived from this investigation appear to align with the underlying mechanisms implicated in this process. An additional rationale for the increased thrombopoietic levels observed in the context of malignancy is the accelerated consumption of platelets during their involvement in tumor metastasis. Consequently, the interaction between these molecules and thrombopoietin is diminished, leading to a decrease in its rate of elimination and subsequent elevation in its concentration. Consequently, this increase exerts its influence on the bone marrow, stimulating enhanced platelet production, thereby perpetuating the ongoing cycle.[7]

In instances of benign tumors, there is an absence of supplementary release of thrombopoietic cytokines, which are substances that elevate platelet count. The platelets present prior to surgery are derived solely from the regular physiological secretions of cytokines. Following surgical procedures, there is an absence of reduction in the production of platelet-producing substances. Postoperative platelet levels experience an

increase as a result of a wound healing phenomenon subsequent to surgical procedures.[13]

In individuals diagnosed with malignant neoplasms, it is expected that the postoperative platelet count will decrease compared to preoperative levels. The absence of change or an increase in it may indicate the presence of residual malignant cells and a potentially unfavorable prognosis. In addition, the utilization of flow cytometry, fluorescence microscopy, and intravital microscopy techniques enables the detection of tumor cell-induced platelet aggregation (TCIPA) within the bloodstream, thereby providing valuable insights into the increased likelihood of identifying metastatic events.

There exist multiple sites within the platelet-tumor interaction that can be selectively targeted in order to mitigate the process of metastasis. Significant advancements have been achieved in the domain of P-selectin inhibition through the utilization of unfractionated heparin or specific low molecular weight heparins.[10] This phenomenon would impede the adhesion of platelets to neoplastic cells and subsequently hinder the development of tumor cell-induced platelet aggregates (TCIPAs), which play a crucial role in facilitating metastasis. Additional receptors, including GPIb-IX-V, GPVI, and Integrin $\alpha 2\ \beta 1$, could potentially be targeted for the same purpose. However, it is imperative to conduct further research and clinical trials in order to ascertain their efficacy and safety.

CONCLUSION

Platelets play a significant role in the pathophysiology of cancer. The present study provides further support for the existing research findings regarding the interaction between tumor cells and platelets. Specifically, it confirms the observed increase in platelet count in the bloodstream during the presence of malignancy, followed by a decrease upon its elimination. Therefore, by gaining a deeper understanding of the detrimental impact of platelets in individuals with cancer, it becomes possible to develop suitable medications that can serve as supplementary cancer treatments without compromising the advantageous functions of platelets.

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