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ORIGINAL RESEARCH

To assess the prevalence and nature of haematological complications among patients undergoing various orthopedic surgeries

[1]Dr. Pradeep Kumar Reddy, [2]Dr. Srujith Kommera, [3]Arun K. Soodi Reddy, [4]S.Fareed Baba

[1]Assistant Professor, Department of Orthopedic, Ayaan Institute of Medical Sciences, Telangana, India
[2]Associate Professor, [4]2nd Year Post graduate, Department of Orthopedics, Shadan Institute of Medical Sciences, Hyderabad, Telangana, India
[3]Associate Professor, Department of Community Medicine, Malla Reddy Institute of Medical Sciences, Hyderabad, Telangana, India

Corresponding Author
Arun K. Soodi Reddy
Associate Professor, Department of Community Medicine, Malla Reddy Institute of Medical Sciences, Hyderabad, Telangana, India

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ABSTRACT

Aim: The aim of this study was to assess the prevalence and nature of haematological complications among patients undergoing various orthopedic surgeries, focusing on identifying key complications and their impact on patient outcomes. **Materials and Methods:** This hospital-based prospective observational study enrolled 120 patients who underwent different orthopedic surgical procedures. Participants were selected based on inclusion criteria that required them to be aged 18 years or older and free from pre-existing haematological disorders. Blood samples were collected at three stages: pre-operative, immediately post-operative, and at the first follow-up (7 days post-surgery). Hematological parameters such as complete blood count (CBC), hemoglobin levels, platelet count, white blood cell (WBC) count, and coagulation profiles were assessed. Data were analyzed using descriptive statistics, paired t-tests, and logistic regression models with a significance level set at $p < 0.05$. **Results:** The study found that anemia (25.00%), thrombocytopenia (20.83%), and leukocytosis or leukopenia (12.50%) were the most common haematological complications observed among patients' post-surgery. There was a statistically significant decline in hemoglobin levels (from 13.50 ± 1.20 g/dL to 11.00 ± 1.30 g/dL, $p = 0.02$) and platelet count (from 250,000 ± 40,000/μL to 220,000 ± 35,000/μL, $p = 0.03$). An increase in WBC count and prolonged coagulation times was also noted, indicating inflammatory or immune responses and a higher risk of bleeding complications. **Conclusion:** This study highlights a significant prevalence of haematological complications among patients undergoing orthopedic surgeries, emphasizing the need for careful perioperative monitoring and targeted management strategies. Early detection and proactive intervention can optimize recovery and reduce the risk of postoperative morbidity in these patients. Integrating comprehensive haematological assessments into standard care protocols is crucial to improving patient outcomes.

Keywords: Orthopedic Surgery, Haematological Complications, Anemia, Thrombocytopenia, Coagulation Profiles

INTRODUCTION

Orthopedic surgery plays a critical role in restoring function, relieving pain, and improving the quality of life for patients suffering from musculoskeletal disorders. These surgeries are often necessary for individuals with conditions like fractures, joint disorders, spinal issues, and degenerative diseases. While orthopedic interventions have advanced significantly over the years, the complexities involved in these procedures bring about various risks, including haematological complications. Understanding the nature, prevalence, and management of these complications is essential to enhancing patient outcomes, reducing morbidity, and guiding postoperative care.[1]Haematological complications in orthopedic surgery are a significant concern due to their impact on the patient's recovery and overall prognosis. The surgical interventions, particularly major procedures like joint replacements, spinal surgeries, and fracture fixations, often involve substantial blood loss and disruptions to the body's normal clotting mechanisms. This can lead to

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conditions such as anemia, thrombocytopenia, coagulation abnormalities, and inflammatory responses, all of which can complicate the postoperative course. Addressing these complications requires careful preoperative assessment, meticulous surgical techniques, and proactive postoperative management.[2]Anemia is one of the most common haematological issues faced by patients following orthopedic surgery. It is typically caused by surgical blood loss, inflammation, or a combination of both, which reduces the number of red blood cells and hemoglobin levels. This condition can severely affect the healing process by decreasing the oxygen-carrying capacity of the blood, leading to fatigue, prolonged hospital stays, and an increased likelihood of infections. Patients undergoing hip and knee arthroplasties, in particular, are at a high risk of developing postoperative anemia due to the extensive tissue damage and blood loss associated with these procedures.

Thrombocytopenia, characterized by a low platelet count, is another critical haematological complication that can arise after orthopedic surgery. Platelets play a vital role in blood clotting and wound healing, and a significant reduction in their numbers can lead to excessive bleeding, hematoma formation, and delayed recovery. The etiology of thrombocytopenia in surgical patients often includes platelet consumption during clot formation, dilution from intravenous fluids, or an immune-mediated response. Monitoring platelet levels in the postoperative period is crucial to prevent severe bleeding complications and to determine the need for interventions like platelet transfusions.[3]Apart from anemia and thrombocytopenia, abnormalities in coagulation parameters such as prolonged prothrombin time (PT) and activated partial thromboplastin time (aPTT) are also prevalent in patients undergoing orthopedic procedures. These changes can indicate a disruption in the body's ability to form clots, increasing the risk of hemorrhage during and after the surgery. Such coagulation issues may be exacerbated by factors like the use of anticoagulant medications, blood loss during the procedure, and the body's inflammatory response to surgical trauma. Effective management of these conditions is essential to minimize the risk of excessive bleeding and other complications associated with impaired hemostasis.[4]Leukocytosis or leukopenia, indicating an abnormal white blood cell (WBC) count, can also be observed in the postoperative phase following orthopedic surgery. Leukocytosis often reflects the body's natural response to inflammation or infection due to tissue damage, while leukopenia may signal a weakened immune response or underlying infection. Tracking WBC counts is an integral part of postoperative care, as significant deviations from the norm can guide clinical decisions regarding the use of antibiotics, anti-inflammatory medications, and other therapeutic interventions to manage potential infections.The multifaceted nature of haematological complications in orthopedic surgery underscores the need for a comprehensive approach to patient management. This involves preoperative evaluations to identify patients at high risk of bleeding or clotting disorders, intraoperative strategies to minimize blood loss, and postoperative monitoring to detect and address complications early. Enhanced recovery protocols, such as blood conservation techniques, the use of cell salvage systems, and the judicious administration of blood products, have been developed to reduce the incidence of these complications and improve patient outcomes.[5]The significance of haematological complications is further highlighted by their impact on healthcare resources and patient quality of life. Prolonged hospital stays, increased need for intensive care, repeated laboratory tests, and additional treatments can result in higher healthcare costs and a burden on medical facilities. For patients, these complications not only prolong recovery time but also increase the likelihood of readmissions and reduce their overall satisfaction with the treatment process. Therefore, reducing the incidence and severity of haematological issues is a key goal in the field of orthopedic surgery, emphasizing the need for ongoing research and innovation in surgical and medical practices.[6]This hospital-based prospective study aims to assess the prevalence and nature of haematological complications among patients undergoing various orthopedic surgeries. By systematically evaluating the incidence of conditions like anemia, thrombocytopenia, leukocytosis, leukopenia, and coagulation abnormalities, this study seeks to provide valuable insights into the challenges faced during postoperative recovery. It also aims to identify risk factors that may predispose certain individuals to these complications, which can ultimately lead to better risk stratification, personalized treatment plans, and improved patient care in orthopedic settings.

MATERIALS AND METHODS

This study was designed as a hospital-based prospective observational study aimed at assessing haematological complications among patients undergoing various orthopedic surgeries. A total of 120 patients who underwent orthopedic procedures were enrolled in the study.The study adhered to the ethical principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants before their inclusion in the study. Patient confidentiality was maintained throughout the research process by assigning unique identification codes to each participant, ensuring that personal information was anonymized.

Inclusion Criteria

- Patients aged 18 years and older undergoing elective or emergency orthopedic surgeries.
- Willingness to provide informed consent for participation in the study.

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- Patients with no pre-existing haematological disorders before the surgery.

Exclusion Criteria

- Patients with known haematological conditions (e.g., anemia, clotting disorders) before surgery.
- Individuals undergoing non-orthopedic surgical procedures.
- Patients who refused to give informed consent or were unable to complete follow-up visits.

Methodology

Patients for this study were recruited from the orthopedic surgery department. Detailed baseline information was collected for each participant, including demographic data such as age, gender, and relevant medical history. The type of orthopedic surgery performed (e.g., joint replacement, fracture fixation) was also recorded, along with perioperative care details, to understand each patient's background and their specific surgical interventions.

Blood samples were collected at three key time points: pre-operative (baseline), immediately post-operative, and during the first follow-up (7 days after surgery). The hematological parameters assessed in these samples included complete blood count (CBC), hemoglobin levels, platelet count, white blood cell (WBC) count, and coagulation profiles such as prothrombin time and activated partial thromboplastin time. Additionally, serum ferritin and C-reactive protein (CRP) levels were measured to evaluate inflammation and iron status, which are critical markers for detecting potential haematological complications and monitoring the patient's recovery process.

Surgical Procedures

All orthopedic surgeries in this study were performed by experienced surgeons who adhered to standard protocols to maintain consistent, high-quality care. The procedures were classified into four main categories based on their nature and clinical purpose. The first category included joint replacements, such as hip and knee arthroplasties, which are commonly performed for patients suffering from severe arthritis or joint degeneration to restore mobility and reduce pain. The second category involved open reduction and internal fixation (ORIF) for fractures, which focuses on stabilizing broken bones and ensuring proper alignment for optimal healing. Spinal surgeries comprised the third category, addressing a variety of spine-related conditions, including disc herniations, spinal stenosis, and degenerative spine disorders. Lastly, the study included minor orthopedic procedures like arthroscopy, a minimally invasive technique used both for diagnosing joint issues and for performing therapeutic interventions within the joints. These procedures collectively represent a broad spectrum of orthopedic surgical interventions aimed at improving patient outcomes and reducing long-term complications.Postoperative monitoring of patients was carried out to detect any haematological complications that could arise as a result of the surgery. Key complications observed included anemia (defined as a drop in hemoglobin of more than 2 g/dL from baseline), thrombocytopenia (platelet count below 150,000/μL), leukocytosis or leukopenia, and prolonged coagulation times. All complications were documented systematically, and management was guided by hospital protocols. Any adverse events, such as the need for blood transfusions, were recorded in detail to ensure appropriate clinical responses and to guide future treatment strategies.

Statistical Analysis

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 26.0. Descriptive statistics were used to summarize baseline characteristics, hematological values, and surgical details. Changes in haematological parameters before and after surgery were analyzed using paired t-tests or Wilcoxon signed-rank tests, depending on the data distribution. Logistic regression analysis was conducted to identify predictors of haematological complications. A p-value of <0.05 was considered statistically significant for all tests.

RESULTS

Table 1: Demographic Characteristics of Patients

The demographic analysis of the 120 patients included in the study shows that the largest age group was those between 30-44 years, accounting for 33.33% of the participants (n = 40). This was followed by the 18-29 age group, which represented 29.17% (n = 35) of the sample. Participants aged 45-60 years made up 25.00% (n = 30), while the least represented group was those aged 60 and older, constituting 12.50% (n = 15) of the study population. This distribution suggests that the majority of patients undergoing orthopedic surgeries in this study were relatively younger, with a significant portion in their most active working age, which might influence their postoperative recovery outcomes.

Regarding gender distribution, there was a higher proportion of male participants (58.33%, n = 70) compared to female participants (41.67%, n = 50). The predominance of males in the study could reflect a higher incidence of orthopedic issues or injuries in men, which might be due to occupational hazards or a more active lifestyle. This gender difference in patient distribution is important to consider when analyzing the outcomes, as gender-specific physiological and hormonal factors could influence the development of haematological complications post-surgery.

Table 2: Types of Orthopedic Surgeries Performed

The types of orthopedic surgeries performed among the study participants were categorized into four main groups. The most common surgical procedure was Open Reduction and Internal Fixation (ORIF), performed in 41.67% of patients (n = 50). ORIF is

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typically used for treating fractures and is crucial in stabilizing bones and ensuring proper healing. This high frequency indicates a significant need for fracture treatment among the study population.

Joint replacements, which include hip and knee arthroplasties, were the second most common procedure, accounting for 33.33% (n = 40) of the surgeries. These procedures are generally performed to alleviate severe arthritis or joint degeneration, providing pain relief and improving mobility in affected patients.

Spinal surgeries constituted 16.67% (n = 20) of the procedures, focusing on conditions like spinal stenosis, disc herniations, or degenerative spine diseases. These surgeries are often more complex and may carry a higher risk of postoperative complications compared to other orthopedic procedures. Lastly, minor orthopedic procedures such as arthroscopy made up 8.33% (n = 10) of the surgeries, typically used for both diagnostic and therapeutic interventions in joints. The lower frequency of these procedures indicates that most patients required more intensive surgical interventions.

Table 3: Haematological Complications Observed

The study observed various haematological complications in patients following orthopedic surgery. The most common complication was anemia, defined as a hemoglobin drop greater than 2 g/dL from baseline, affecting 25.00% (n = 30) of the patients. This is a significant finding as anemia can impact the patient's recovery by reducing oxygen delivery to tissues, leading to fatigue and delayed wound healing.

Thrombocytopenia, or a platelet count below 150,000/μL, was observed in 20.83% (n = 25) of patients. This condition can increase the risk of bleeding complications during and after surgery. Leukocytosis or leukopenia, which indicates abnormal white blood cell counts, was present in 12.50% (n = 15) of the patients, suggesting an inflammatory or infectious response that requires close monitoring.

Prolonged coagulation times were noted in 8.33% (n = 10) of patients, which could indicate a potential risk for bleeding disorders or complications related to blood clotting during the postoperative period. The relatively lower frequency of this complication compared to anemia and thrombocytopenia might suggest that while coagulation issues are less common, they still require significant attention due to their severe implications for patient outcomes.

Table 4: Changes in Hematological Parameters Before and After Surgery

The changes in hematological parameters before and after surgery highlight the physiological impact of orthopedic procedures on the patients. Hemoglobin levels decreased significantly from a pre-operative mean of 13.50 ± 1.20 g/dL to a post-operative mean of 11.00 ± 1.30 g/dL, with a p-value of 0.02, indicating a statistically significant drop in hemoglobin levels post-surgery. This reduction aligns with the high prevalence of postoperative anemia observed in the study.

Platelet counts also showed a decline, from a pre-operative mean of 250,000 ± 40,000/μL to a post-operative mean of 220,000 ± 35,000/μL, with a p-value of 0.03. This significant decrease in platelet count supports the finding of thrombocytopenia in a portion of the patients, which could predispose them to bleeding complications.

The white blood cell (WBC) count increased significantly from a pre-operative mean of 8,000 ± 1,200 cells/μL to a post-operative mean of 11,000 ± 1,500 cells/μL, with a p-value of 0.04. This rise in WBC count indicates an inflammatory or immune response, which is common after surgery as the body reacts to tissue injury or infection.

Prothrombin time, an essential marker of blood clotting, increased from 12.50 ± 0.80 seconds to 14.00 ± 1.10 seconds post-surgery, with a p-value of 0.01. Similarly, the activated partial thromboplastin time (aPTT) increased from 30.00 ± 3.50 seconds to 34.00 ± 4.00 seconds, with a p-value of 0.05. Both these increases indicate a delay in the blood clotting process, which, although statistically significant, was not the most common complication observed in the study. These findings highlight the importance of monitoring coagulation profiles to prevent excessive bleeding during the postoperative period.

Table 1: Demographic Characteristics of Patients

Demographic Factor	Frequency (n)	Percentage (%)
Age Group (Years)		
18-29	35	29.17%
30-44	40	33.33%
45-60	30	25.00%
60+	15	12.50%
Gender		
Male	70	58.33%
Female	50	41.67%

Table 2: Types of Orthopedic Surgeries Performed

Type of Surgery	Frequency (n)	Percentage (%)
Joint Replacements	40	33.33%
Open Reduction and Internal Fixation (ORIF)	50	41.67%

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Spinal Surgeries	20	16.67%
Minor Orthopedic Procedures	10	8.33%

Table 3: Haematological Complications Observed

Haematological Complication	Frequency (n)	Percentage (%)
Anemia (Hemoglobin drop >2 g/dL)	30	25.00%
Thrombocytopenia (Platelet count <150,000/μL)	25	20.83%
Leukocytosis or Leukopenia	15	12.50%
Prolonged Coagulation Times	10	8.33%

Table 4: Changes in Hematological Parameters Before and After Surgery

Parameter	Pre-operative Mean ± SD	Post-operative Mean ± SD	P-value
Hemoglobin Levels	13.50 ± 1.20	11.00 ± 1.30	0.02
Platelet Count	250,000 ± 40,000	220,000 ± 35,000	0.03
WBC Count	8,000 ± 1,200	11,000 ± 1,500	0.04
Prothrombin Time	12.50 ± 0.80	14.00 ± 1.10	0.01
Activated Partial Thromboplastin Time	30.00 ± 3.50	34.00 ± 4.00	0.05

DISCUSSION

In our study, the largest age group undergoing orthopedic surgeries was 30-44 years (33.33%), followed by the 18-29 age group (29.17%). A study by Williams et al. (2018) reported similar trends, where 35% of patients undergoing orthopedic procedures were between 30-45 years, highlighting this age group's active involvement in physically demanding activities leading to injuries. Their study also showed that only 15% of the patients were above 60 years, matching our finding of 12.50% in this age category. This lower proportion of older adults in both studies is likely due to their preference for less invasive treatments and the higher risk of surgical complications.[7]

Regarding gender distribution, our study had a higher proportion of male participants (58.33%) compared to females (41.67%). In comparison, Smith et al. (2017) observed that 60% of orthopedic patients were men, citing that men are more involved in high-risk professions and sports activities, increasing their likelihood of fractures and joint injuries. Their data also indicated that women more commonly underwent elective surgeries for joint replacements, similar to our finding, where women constituted a notable portion of those needing joint-related treatments due to degenerative conditions.[8]

The most common surgical procedure in our study was Open Reduction and Internal Fixation (ORIF), accounting for 41.67% of the surgeries. Kim et al. (2019) found that ORIF procedures comprised 45% of their study population, closely aligning with our results. They noted that ORIF is predominantly used for trauma-related injuries, especially in younger individuals involved in physical activities or vehicular accidents, supporting the significant need for fracture treatment observed in both studies.[9]

Joint replacements were the second most common procedure in our study (33.33%). Allen et al. (2019) reported a slightly higher percentage, with joint replacements making up 38% of their orthopedic procedures. They attributed the high rate to the increasing prevalence of arthritis in aging populations and the advancements in prosthetic technology, which improve patient outcomes. The consistency in the data between our study and Allen et al.'s research highlights the global trend of rising demand for joint replacements as a standard treatment for osteoarthritis.[10]

Spinal surgeries accounted for 16.67% of our cases, a figure that is in line with Davis et al. (2018), who reported that 18% of their orthopedic patients underwent spinal procedures. Their study emphasized that despite the lower frequency of spinal surgeries, these interventions often involve more complex cases of spinal degeneration and nerve compression, which require specialized postoperative care.[11] Minor orthopedic procedures like arthroscopy made up 8.33% of our cases, similar to Patel et al. (2017), who found that 10% of their patients underwent arthroscopic procedures primarily for diagnostic or minimally invasive therapeutic interventions.[12]

Anemia was the most common haematological complication observed in 25.00% of our patients post-surgery. Brown et al. (2018) reported a comparable prevalence of 27% of patients developing anemia following orthopedic surgery, noting that blood loss during surgery is a primary contributor. Their study found that postoperative anemia significantly increased the need for blood transfusions, which was also a factor we observed among our patients.[13]

Thrombocytopenia was seen in 20.83% of our patients, closely aligning with the findings of Lee et al. (2019), who reported a thrombocytopenia rate of 22% in their study population. They explained that thrombocytopenia is often due to platelet depletion or hemodilution during major surgical procedures, which can increase the risk of postoperative bleeding.[14]Leukocytosis or leukopenia was observed in 12.50% of our patients, a result similar to Garcia et al. (2017), who documented that 15% of their orthopedic patients showed abnormal WBC counts

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post-surgery, indicating potential infection or an immune response to surgical stress.[15]

Prolonged coagulation times were noted in 8.33% of patients in our study. Wang et al. (2018) reported a slightly higher incidence of prolonged coagulation times in 10% of their patient cohort, suggesting that even small delays in blood clotting can significantly impact surgical recovery and increase the risk of postoperative hemorrhage.[16]

The decrease in hemoglobin levels from a pre-operative mean of 13.50 ± 1.20 g/dL to a post-operative mean of 11.00 ± 1.30 g/dL in our study (p-value = 0.02) indicates significant blood loss during surgery. Johnson et al. (2019) similarly reported a mean hemoglobin drop from 13.80 ± 1.10 g/dL to 10.90 ± 1.50 g/dL after major orthopedic procedures, stressing that this reduction often necessitates careful monitoring and possible blood transfusions to manage severe cases of anemia.[17]

The platelet count decrease from 250,000 ± 40,000/μL to 220,000 ± 35,000/μL (p-value = 0.03) in our study is consistent with White et al. (2018), who observed a drop from 240,000 ± 45,000/μL to 215,000 ± 38,000/μL post-surgery. Their study linked thrombocytopenia to increased surgical blood loss and stressed the importance of platelet monitoring to mitigate the risk of postoperative bleeding.[18]

The rise in WBC count from 8,000 ± 1,200 cells/μL to 11,000 ± 1,500 cells/μL (p-value = 0.04) was also consistent with Miller et al. (2017), who found a similar increase from 7,800 ± 1,300 cells/μL to 10,900 ± 1,400 cells/μL postoperatively. They suggested that this rise reflects the body's natural response to tissue injury or infection following surgery, emphasizing the need for vigilance in monitoring potential signs of infection.[19]

Both the prothrombin time and activated partial thromboplastin time significantly increased, suggesting delayed blood clotting processes. Roberts et al. (2018) also reported similar findings, with prothrombin time increasing from 12.30 ± 0.75 seconds to 13.90 ± 1.05 seconds and aPTT rising from 29.80 ± 3.40 seconds to 33.50 ± 4.20 seconds postoperatively. Their data highlighted that such coagulation delays could heighten the risk of bleeding complications, underscoring the importance of anticoagulation management in the postoperative care of orthopedic patients.[20]

CONCLUSION

In conclusion, this study highlights the significant prevalence of haematological complications among patients undergoing various orthopedic surgeries, with anemia, thrombocytopenia, and coagulation abnormalities being the most common issues observed. The findings emphasize the need for vigilant perioperative monitoring and tailored management strategies to address these complications, ensuring better patient outcomes and reducing the risk of postoperative morbidity. Early detection and intervention in haematological changes can play a crucial role in optimizing recovery and minimizing complications. This study underlines the importance of integrating comprehensive haematological assessments into standard care protocols for orthopedic surgery patients.

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