

ORIGINAL ARTICLE

The Role of Anticoagulants in Postoperative Care: Balancing Risk and Benefits in General and Plastic Surgical Patients

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ABSTRACT

Introduction: Thromboembolic event prevention remains the main application of anticoagulants in postoperative care yet this treatment increases bleeding risks. The maintenance of appropriate risk management between anticoagulation and bleeding stands as an essential requirement particularly for general surgical and plastic surgical patients. The research examines the advantages together with adverse repercussions of anticoagulation therapy in this specific group of patients.

Methodology: The research tracked surgical patients from the general and plastic categories throughout a prospective cohort study by monitoring anticoagulated patients and patients who did not receive anticoagulation. The research tracked two primary effects of thromboembolism and bleeding complications as the main results with additional observations regarding wound healing rates and surgical infections and hospitalization times and patient survival statistics. The statistical analysis employed chi-square with t-tests for data evaluation and established $p \leq 0.05$ as the level of statistical significance.

Results: Anticoagulated patients developed fewer deep vein thrombosis and pulmonary embolism events ($p < 0.05$) while they experienced more serious bleeding conditions that required medical intervention ($p < 0.05$). The groups showed no important differences regarding wound healing, surgical site infection rates and healthcare duration after surgery. The only observed deaths occurred within the non-anticoagulated patient group because of pulmonary embolism.

Conclusion: Conducting anticoagulation therapy minimizes blood clotting dangers while leading to more bleeding events. The successful postoperative management depends on an individualized risk-based strategy along with a balanced approach.

Keywords: Anticoagulation, thromboembolism, bleeding risk, postoperative care, general surgery, plastic surgery

INTRODUCTION

After surgery patients need proper postoperative care because surgeons must simultaneously optimize recovery results and reduce possible complications. The surgical patient population faces major risks from venous thromboembolic complications that can lead to deep vein thrombosis and pulmonary embolism¹. Anticoagulant medications serve to decrease thromboembolic occurrences but healthcare providers need to weigh treatment benefits against bleeding hazards². Doctors must assess potential risks against benefits when deciding to administer anticoagulants during procedures in general and plastic surgery because outstanding outcomes require excellent wound healing and sufficient bleeding control^{3,4}.

The selection of postoperative anticoagulation treatment depends on various elements such as patient-specific health factors including age and coagulation disorders and comorbidities in addition to surgical factors like intraoperative blood loss and tissue manipulation potential and also what medication is utilized as anticoagulant which could include hirudin drugs or direct-acting oral anticoagulants (DOACs) and low-molecular-weight heparins (LMWH), heparin drugs, and vitamin K inhibitors⁵. The need for thromboprophylaxis occurs commonly in general surgery patients who undergo abdominal surgeries, oncological resections or gastrointestinal interventions because bed rest combined with inflammatory responses creates risks for blood clots⁶. Plastic surgeons must exercise caution regarding anticoagulation because reconstructive and aesthetic procedures bring the risk of both hematoma formation and problems with wound healing⁷.

Anticoagulation protocols show recent progress that has shifted healthcare providers to utilize individualized risk assessment models through the Caprini Risk Score for performing thromboprophylaxis⁸. Medical decisions about anticoagulation become complicated because general and plastic surgery patients lack universal procedure-specific guidelines. The existing literature regarding anticoagulant therapy in orthopedic and cardiovascular fields does not match the scarcity of research focusing on general

and plastic surgery patients.⁹

Research Gap and Objective: The present literature about anticoagulation therapies in surgical specialties extends rapidly but insufficient data exists for determining optimal strategies between prevention of thrombosis and control of bleeding risk in the fields of general and plastic surgery. These surgical fields create specific challenges which current guidelines fail to account when making their generic recommendations. This research evaluates anticoagulant treatments in postoperative patient care settings through general and plastic surgery for their advantages and safety-related aspects. Future clinical practice will benefit from these findings because they help create specific thromboprophylaxis strategies for these patient groups which leads to improved postoperative results as well as reduced surgical complications.

METHODOLOGY

Study Design and Setting: A prospective cohort research protocol ran from March 2022 through February 2023 at the Department of General and Plastic Surgery at Mardan Medical Complex, Mardan and Northwest General Hospital & Research Centre, Peshawar. The research investigated postoperative anticoagulant therapy effects among patients who got multiple surgical operations with particular emphasis on advantages and side effects. The Institutional Review Boards provided ethical approval for this study while written informed consent gained participation from all selected study participants.

Sample Size Calculation: Determination of the research sample followed existing estimates for postoperative thromboembolic events occurring among surgical patients. The literature reveals a general incidence range from 3% to 10% when patients do not receive anticoagulation treatment yet bleeding occurs in approximately 5% of anticoagulated patients.¹⁰ The required sample size for the cohort research exceeded 180 patients when using an estimated difference of 7% between groups with an 80% power rate and a 95% confidence interval level. The research applied the Cochran formula for cohort studies to determine the minimum necessary sample size:

$$n = Z^2 P(1-P) / d^2$$

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The calculation used Z equals 1.96 at a 95% confidence level together with P representing 7% thromboembolic events prevalence and d representing 5% as margin of error. The sample size of 200 patients was considered as sufficient even with dropouts and missing data records taken into account.

Patient Selection: The research study incorporated patients who received general surgery care as well as those who had plastic surgery during elective or emergency surgeries. Adult patients aged 18 years and older who needed postoperative anticoagulation treatment as per standard clinical indications for prolonged immobilization or high-risk thrombotic conditions and previous thromboembolic history qualified for inclusion into the study. The study selection excluded patients who could not use anticoagulation medications alongside individuals with coagulopathy and patients with ongoing bleeding issues.

Study Procedure: The study participants were organized into anticoagulated and non-anticoagulated groups depending on their anticoagulation treatment status after surgery. The type of anticoagulant therapy for patients involved either low-molecular-weight heparin or direct oral anticoagulants or vitamin K antagonists which were selected through institutional protocols and Caprini Risk Score risk assessment processes.

Study participants received an assessment on their demographic characteristics and comorbidities and surgical procedures and hospital length of stay together with postoperative complications regarding thromboembolic incidents and bleeding occurrences and wound healing abnormalities. Medical staff diagnosed thromboembolic conditions through clinical assessment which healthcare professionals supported with Doppler ultrasonography for deep vein thrombosis and computed tomography pulmonary angiography for pulmonary embolism. Voluntary bleeding complications were considered minor when patients needed observation or minimal medical care but any bleeding which required surgery or transfusions or ICU admission was classified as major. For the 30-day postoperative patient follow-up both thromboembolic and hemorrhagic complications were evaluated. The main research goal aimed to evaluate how anticoagulation treatments stopped thromboembolism while avoiding significant bleeding incidents. Investigations into wound healing and hospital stay duration as well as morbidity rates constituted the study's additional outcomes.

Statistical Analysis: SPSS version 26 was used to analyze the data. While continuous variables were reported as means and standard deviations (SD) or, where applicable, medians and interquartile ranges (IQR), descriptive statistics were used to characterize categorical data as frequencies and percentages. For categorical comparisons between groups, the Fisher's exact test or chi-square test was employed. The independent t-test for normally distributed data and the Mann-Whitney U test for non-normally distributed data were used to evaluate continuous variables. For bleeding and thromboembolic events, the relative risk (RR) with a 95% CI was computed. In order to account for relevant confounders such as age, comorbidities, and surgical variables, a multivariate logistic regression model was utilized. Statistical significance was defined as a p-value of less than 0.05.

Ethical Considerations: The Declaration of Helsinki's tenets were followed in this investigation. Prior to starting data collection, the institutional ethics committees gave its ethical permission. Participants or their legal guardians gave their informed consent, and all patient data was anonymised to maintain confidentiality. Participants received assurances that their participation was entirely voluntary and that they may leave at any time without facing any repercussions.

RESULTS

The trial had 200 patients, 100 of whom were in the anticoagulated group and 100 of whom were not. There was no significant difference between the groups, and the participants' mean age was 54.3 ± 12.6 years ($p = 0.42$). 57% of the research participants were men, and the distribution of genders was comparable among

groups ($p = 0.59$). The anticoagulated group had higher rates of comorbid diseases, such as DM, HTN, and prior history of thromboembolism (HTN: 48% vs. 36%, $p = 0.08$; DM: 32% vs. 27%, $p = 0.51$) (Table 1).

Table 1: Baseline Characteristics of the Study Population

Characteristic	Anticoagulated (n=100)	Non-Anticoagulated (n=100)	p-value
Age (years, Mean \pm SD)	54.8 ± 11.2	53.7 ± 13.1	0.42
Male Gender (%)	58	56	0.59
Hypertension (%)	48	36	0.08
Diabetes Mellitus (%)	32	27	0.51
Previous Thrombosis (%)	20	12	0.07

The distribution of surgical procedures showed that major abdominal surgeries were the most common in the general surgery cohort (42%), while flap-based reconstructions were predominant in the plastic surgery cohort (38%). There was no statistically significant difference in the type of surgical procedures between groups ($p = 0.67$) (Table 2).

Table 2: Distribution of Surgical Procedures in Study Groups

Surgical Procedure	Anticoagulated (n=100)	Non-Anticoagulated (n=100)	p-value
Major Abdominal Surgery (%)	41	43	0.67
Hernia Repair (%)	15	18	0.52
Flap-Based Reconstruction (%)	38	37	0.78
Skin Grafts (%)	6	7	0.82

The incidence of thromboembolic events was significantly lower in the anticoagulated group compared to the non-anticoagulated group (3% vs. 12%, $p = 0.01$). DVT was observed in six patients, five of whom belonged to the non-anticoagulated group ($p = 0.03$). Pulmonary embolism (PE) occurred in three patients, all from the non-anticoagulated group (Figure 1).

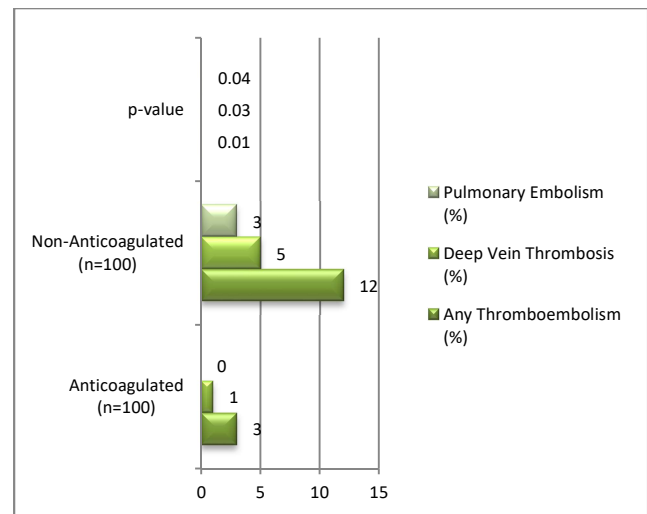


Figure 1: Thromboembolic Events in Study Groups

The non-anticoagulated group had a considerably increased risk of thromboembolism, as evidenced by the estimated relative risk (RR) of 4.0 (95% CI: 1.2–13.3, $p = 0.02$) of experiencing thromboembolic events in the absence of anticoagulation. Compared to the non-anticoagulated group, the anticoagulated group experienced a greater overall incidence of bleeding problems (14% vs. 6%, $p = 0.04$). Five patients in the

anticoagulated group and one in the non-anticoagulated group experienced significant bleeding that necessitated transfusion or surgery ($p = 0.07$) (Table 3).

Table 3: Bleeding Complications in Study Groups

Bleeding Complication	Anticoagulated (n=100)	Non-Anticoagulated (n=100)	p-value
Any Bleeding (%)	14	6	0.04
Major Bleeding (%)	5	1	0.07
Minor Bleeding (%)	9	5	0.21

Wound healing disturbances were recorded in 10% of the anticoagulated group and 7% of the non-anticoagulated group, but the difference was not statistically significant ($p = 0.44$). Surgical site infections (SSIs) occurred in 8% of anticoagulated patients compared to 5% in the non-anticoagulated group ($p = 0.37$) (figure 2).

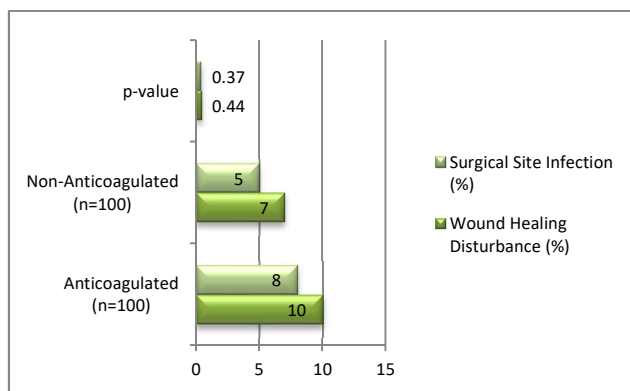


Figure 2: Wound Healing and Surgical Site Complications

Although the anticoagulated group's mean length of hospital stay was somewhat greater (7.8 ± 2.1 days) than the non-anticoagulated group's (6.9 ± 1.9 days), the difference was not statistically significant ($p = 0.09$). Three patients (1.5% of the entire trial population) died; they were all in the non-anticoagulated group and had all acquired PE after surgery (Table 4).

Table 4: Length of Hospital Stay and Mortality

Outcome	Anticoagulated (n=100)	Non-Anticoagulated (n=100)	p-value
Hospital Stay (Days, Mean \pm SD)	7.8 ± 2.1	6.9 ± 1.9	0.09
Mortality (%)	0	3	0.07

Age, comorbidities, and surgery type were among the factors that were taken into account using a multivariate logistic regression analysis. Independently, anticoagulation was linked to a greater risk of bleeding problems (adjusted OR = 2.5, 95% CI: 1.1–6.2, $p = 0.03$) but a decreased risk of thromboembolism (adjusted OR = 0.26, 95% CI: 0.07–0.95, $p = 0.04$).

DISCUSSION

The present study investigated the role of anticoagulants in postoperative care among general and plastic surgical patients, balancing the risk of thromboembolic events and bleeding complications. The findings demonstrated that anticoagulation significantly reduced thromboembolic events, with a lower incidence of deep vein thrombosis and pulmonary embolism in the anticoagulated group. However, anticoagulation was also associated with an increased risk of bleeding complications, particularly major bleeding requiring transfusion or surgical intervention. No significant differences were observed in wound

healing disturbances, surgical site infections, or hospital stay between the two groups, though mortality was only reported in non-anticoagulated patients due to pulmonary embolism.

The results of this study align with previous research showing that anticoagulant therapy effectively reduces the risk of postoperative thromboembolism¹¹. Studies in various surgical specialties have consistently highlighted the protective role of anticoagulants in preventing deep vein thrombosis and pulmonary embolism, especially in high-risk patients¹². The observed reduction in thromboembolic events in this study is comparable to findings reported in large-scale clinical trials evaluating prophylactic anticoagulation in surgical patients¹³.

However, the increased incidence of bleeding complications is consistent with concerns raised in other studies that examined postoperative hemorrhagic risks associated with anticoagulation¹⁴. Previous literature has reported that while anticoagulants significantly decrease thrombotic events, they may lead to higher rates of surgical site hematomas, reoperations due to bleeding, and transfusion requirements, similar to the findings in this study⁵. Additionally, research on surgical site infections and wound healing has been inconclusive, with some studies reporting an increased risk due to anticoagulation-related microvascular effects, while others have found no significant difference, in agreement with the present study's findings¹⁶. The length of hospital stay and mortality outcomes in this study suggest that while anticoagulation does not significantly prolong hospitalization, it may provide survival benefits by reducing the risk of fatal pulmonary embolism. This observation is in line with findings from studies assessing perioperative mortality in patients with thromboembolic complications¹⁷.

Limitations and Future Recommendations This analysis presents multiple restrictions during its execution. The research design used an appropriate number of participants to identify differences in thromboembolic and bleeding events yet it might underrepresent the evaluation of rarer complications. The study took place at only one institution which restricts the ability to generalize its findings beyond specific populations that follow different anticoagulation procedures and surgical practices. The study did not consider postoperative anticoagulation adherence levels of patients or address individual differences in bleeding risk. Future examination of surgical populations needs larger scale multihospital trials which will confirm these results among different surgical patient demographics. Senior research teams must continue their investigations to develop optimized anticoagulant protocols which will provide protection from thromboembolism while maintaining low bleeding risk. The exploration of new anticoagulant medications with enhanced safety attributes can solve the current problem regarding the matching of prevention of blood clots with bleedings risks. Risk-based assessment models developed for individual patients should help optimize treatment with anticoagulants for obtaining superior postoperative results.

CONCLUSION

The results of this research demonstrate that anticoagulant medications play a vital role during postoperative patient care because they decrease thromboembolism rates at the cost of increased bleeding events in both general surgical and plastic surgery patients. Anticoagulation shows effectiveness in stopping deep vein thrombosis alongside pulmonary embolism while preserving normal wound repair and hospitalization duration. Proper patient selection and risk assessment become necessary due to bleeding complications that result from anticoagulant treatments. The improvement of anticoagulation protocols alongside precise risk assessment methods will improve patient outcomes alongside lowering potential side effects.

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