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Association of Aspirin Use With Postoperative Hematoma and Bleeding Complications in Foot and Ankle Surgery: A Retrospective Study

Mohammed K. Hassan, DPM[1], Lawrence G. Karlock, DPM, FACFAS[2]

[1] *Resident Physician, Department of Podiatric Medicine and Surgery, East Liverpool City Hospital, East Liverpool, OH*
[2] *Attending Physician, Austintown Podiatry Associates Inc., Austintown, OH*

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ABSTRACT

Discontinuation of nonsteroidal antiinflammatory drugs 3 to 5 days before elective or nonelective foot and ankle surgery has been recommended, as its continued use during the perioperative period may result in complications; however, data supporting this are limited. In this study, we evaluated the incidence of postoperative bleeding, hematoma formation, and wound dehiscence after perioperative aspirin ingestion before foot and ankle surgery. The medical records of 379 patients treated over a 3-year period were reviewed. Patient demographics, surgical procedures, affected limbs (right foot versus left foot), anatomical surgical sites (forefoot, midfoot, and rearfoot), and week 2 surgical site inspection data were recorded. Mean patient age was 60.12 (range 21 to 81) years, and the overall wound complication rate was 0.80%. The patients were classified into 2 groups: those who took 81 mg of aspirin preoperatively (n = 238, 62.80%) and those who did not (n = 141, 37.20%). Of the 3 patients who developed postoperative bleeding complications, 2 were taking aspirin and 1 was not. Patients taking aspirin had similar wound complication and healing rates as those not taking aspirin. Postoperative hematomas were evacuated in the clinic under sterile conditions and healed by secondary intention. Perioperative aspirin use appears to be safe and effective in foot and ankle surgery, and patients taking aspirin had good surgical outcomes with minimal postoperative complications.

Aspirin, an acetylated salicylate (acetylsalicylic acid), is a nonsteroidal antiinflammatory drug (NSAID). The medication was introduced in 1899 by Bayer (1). Daily low-dose aspirin is often prescribed for patients with a high risk of blood clots, stroke, and heart attack. Initiating such a regimen immediately after a heart attack minimizes the effects of clotting and prevents further damage to the cardiac tissue. Aspirin inhibits cyclooxygenase (COX)-1 and COX-2 enzymes in a dose-dependent manner, thus inducing an antithrombotic effect and stopping prostaglandin production, which provides analgesic and antipyretic effects (1,2).

Aspirin use for secondary prevention of cardiovascular diseases is well known; however, clinical trials and meta-analyses have shown that it reduces the risk of cardiovascular diseases in low-risk patients but increases the risk of bleeding in some individuals (3). It was common for people to be instructed to stop taking aspirin up to 7 days before surgery to reduce postoperative bleeding. Evidence has shown both coronary and vascular adverse effects after aspirin cessation (4). Once aspirin is stopped, there may be a rebound period with increased thromboxane production and decreased fibrinolysis that produce a clinically prothrombotic state (4). This rapid rebound is seen especially in patients who stop taking low-dose aspirin perioperatively.

When used for primary prevention of cardiovascular diseases, aspirin may be stopped without any adverse effects (5). Patients with a history of carotid and coronary stents are required to continue aspirin preoperatively for general, orthopedic, urologic, and vascular surgeries. The continuation of aspirin therapy is probably safe; however, further studies are required to fully understand the implications (5). There is no indication to start patients on low-dose aspirin if they have stable ischemic heart disease. In neurosurgery, it is recommended that aspirin should be discontinued during the perioperative period to avoid bleeding in noncompressible closed spaces during elective craniotomy (6).

The American Orthopaedic Foot and Ankle Society recommends stopping aspirin before any foot and ankle surgery owing to the potentially increased risk of bleeding (7). Such bleeding risk is also associated with postoperative surgical site morbidity and wound dehiscence. To the best of our knowledge, research on the frequency of postoperative hematoma in patients taking aspirin and undergoing same-day outpatient surgery is lacking in the foot and ankle literature.

In this study, we were interested in determining whether aspirin had any effect on the development of hematoma and bleeding

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Address correspondence to: Mohammed K. Hassan, DPM, East Liverpool City Hospital, 425 W 5th St, East Liverpool, OH 43920.
E-mail address: mohammed.hassan@samuelmerritt.edu (M.K. Hassan).

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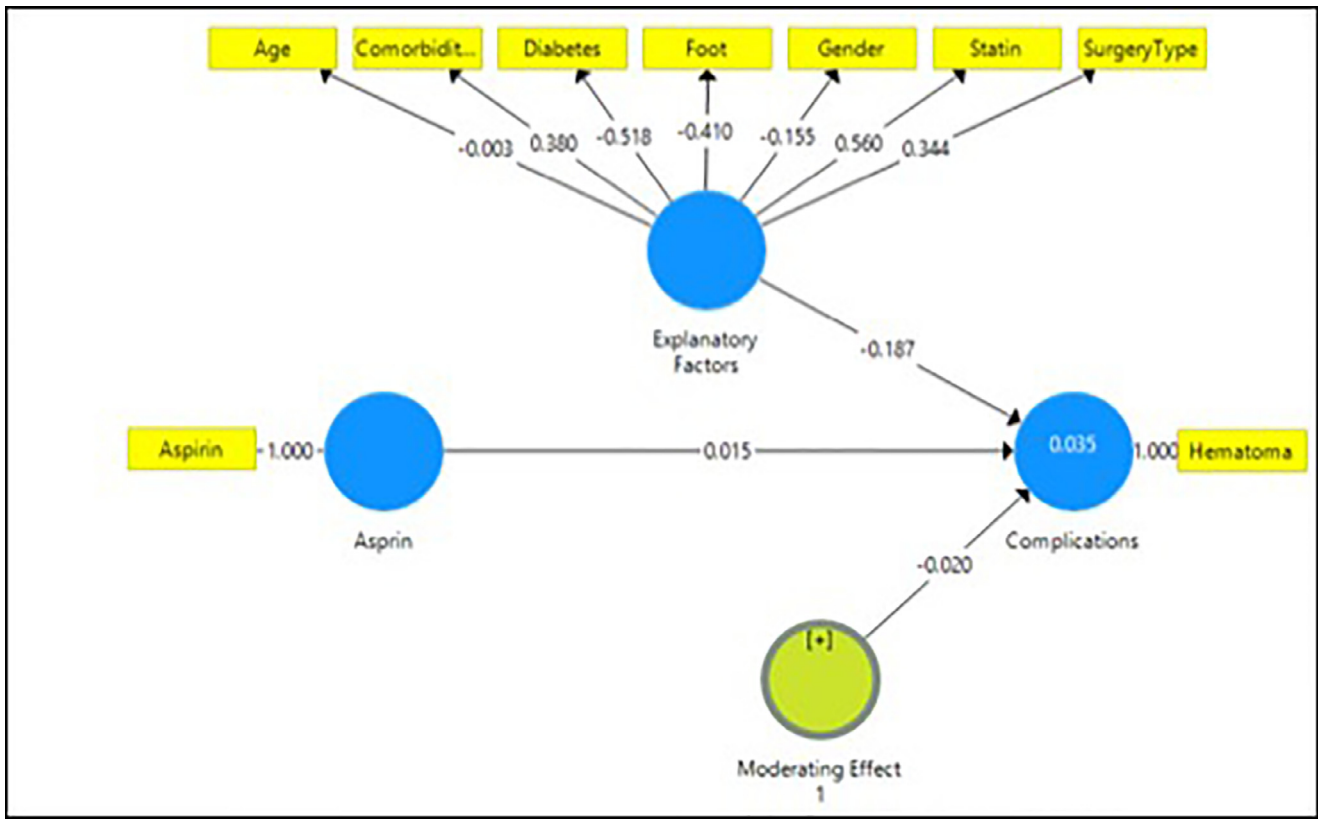

Fig. Partial least squares path modeling: factors influencing the occurrence of hematoma. The coefficients for aspirin were very marginal (0.015), with the explanatory factors accounting for the greatest variation in the occurrence of hematoma (−0.187). The moderating effect of the explanatory factors on the relationship between aspirin and hematoma had a very weak coefficient of −0.020. The total variance for hematoma by the factors investigated was only 3.5%, as represented by an r^2 of 0.035. Effectively, the explanatory factors investigated could not account for the 96.5% variation in the occurrence of hematoma.

complications in outpatient surgery. We hypothesized that aspirin use has a negligible effect on postoperative hematoma formation and bleeding complications. Our primary aim was to identify the number of patients with such complications 2 weeks after surgery. The secondary aim was to understand whether there is a strong association of postoperative hematoma and bleeding complications with statin therapy, diabetes, age, sex, associated foot (right versus left), types of surgery (forefoot, midfoot, and rearfoot), and other comorbidities. We performed a retrospective cohort study to determine the rate of complications resulting from continued perioperative aspirin use.

Patients and Methods

After obtaining approval from the Institutional Review Board of Western Reserve Health Education (approval no. WRHE 12-10-0011-R), a medical record review was conducted. We identified 379 consecutive patients who had undergone forefoot, midfoot, and rearfoot surgery at the Orthopedic Surgery Center of Boardman, an outpatient surgery center. The procedures were performed by the same board-certified foot and ankle surgeon from January 2015 to December 2017. All patients were treated by the senior author (L.G.K.).

In this study, some patients were taking 81 mg of aspirin daily for primary and secondary prevention of cardiovascular disease. The senior author (L.G.K.) did not instruct the patient to continue or discontinue aspirin before or after surgery: the decision was left to the discretion of the patient and his or her primary care physician. Preoperative weightbearing x-ray images obtained for surgical planning for all patients were reviewed by the senior author (L.G.K.). Patients' level of discomfort had to be high enough to request surgical correction. The first author (M.K.H.) collected data from the individual medical records, including age, sex, location of surgery, the foot that underwent operation, perioperative aspirin use, postoperative hematoma in week 2, need for transfusion, reoperation, diabetes, statin therapy status, and other comorbidities. Informed consent was obtained from all patients before surgery. In addition, they all received 1 dose of prophylactic antibiotic before their procedures. Patients were excluded if they were younger than 18 years, were pregnant, or had blood disorders such as factor V Leiden deficiency and hemophilia. The criteria for hematomas were as follows: elevation and discoloration of wound edges, discomfort, swelling, redness, wound dehiscence, and loosening of sutures. These findings had to be present at the surgical site during the 2-week follow-up visit to be considered a postsurgical hematoma.

To test the relationship between aspirin use and occurrence of hematoma and to establish the significance of parametric and nonparametric tests, the Shapiro-Wilk test for normality was used for the key constructs. Statistical significance was set at $p \leq .05$. IBM SPSS Statistics for Macintosh version 24.0 (IBM Corp., Armonk, NY) was used to perform Fisher's exact test. To evaluate whether other factors influenced the occurrence of hematoma, structural equation modeling (8) was used. Because the sample size was very low and the distributions were highly skewed, the partial least squares standard error of the mean was performed using SmartPLS (SmartPLS GmbH, Bönningstedt, Germany) (9). The resultant model is shown in the Fig.

Results

We reviewed 379 patients' charts from 2015 to 2017 for patients whose surgeries were performed at the Orthopedic Surgery Center and who met the inclusion criteria. Of those patients, 214 had undergone forefoot procedures such as hammertoe or bunion corrections, 119 had undergone a midfoot osteotomy or fusion procedure, and 46 had undergone rearfoot procedures such as calcaneal spur resections or gastrocnemius–Achilles tendon lengthening procedures. The mean age of the patients was 60.77 (range 27 to 81) years (women, n = 204, 54%; men, n = 175, 46%). There were 185 (48.81%) patients who had undergone left foot procedures, 185 (48.81%) who had undergone right foot procedures, and 9 (2.37%) who had undergone bilateral foot procedures. A total of 238 (62.80%) patients were taking 81 mg of aspirin

Table 1
Patient demographics (n = 388 feet in 379 patients)

Factor	n (%)	Hematoma in Week 2 (n = 3), n (%)	*p* Value
Aspirin use (n = 379)			.688
Taking aspirin	238 (62.80)	2 (66)	
Not taking aspirin	141 (37.20)	1 (33)	
Surgical limb (n = 388)			.205
Left	185 (47.68)		
Right	185 (47.68)		
Both	18 (4.64)		

perioperatively, and 141 (37.20%) patients were not taking aspirin during that time. Three patients had hematomas at the surgical site at week 2. Of those 3 patients, 2 were taking aspirin before the surgery for the prevention of primary cardiovascular complications prescribed by their primary care physician, and 1 patient was not on aspirin. All 3 patients were found to be noncompliant and continued to walk on the operated foot in the first week of surgery despite receiving instruction to be non-weightbearing for at least 4 to 6 weeks. None of the patients required reoperation, and none required transfusion for excessive blood loss. Of all study patients, 195 (51%) were diabetic, 184 (48%) were nondiabetic, 141 (37%) were not taking aspirin, and 238 (63%) were taking aspirin (Table 1).

Table 1 shows the data of patients in terms of surgical limb operation, aspirin use, presence of hematoma in week 2, and the number of patients with wound complications using aspirin and those with wound complications not using aspirin. Table 2 presents the results of the normality test. The *p* value based on the Shapiro-Wilk test was .061, which is <.01, and this can be attributed to the highly skewed and non-normally distributed data. Given the 2 hypotheses, the nonparametric tests would have sufficed in this case rather than the parametric tests. Fisher's exact test was used, given that the independent and dependent variables were categorical and binary and the sample was <1000 and nonnormally distributed. The results of the Fisher's exact test are presented in Table 3. Based on the outcome of this analysis, the 1-sided exact statistic had a *p* value of .688. The difference in hematoma formation between the aspirin and no-aspirin groups was not statistically significant ($p = .688$, Fisher's exact test).

Discussion

No previous study exclusively investigated the effects of aspirin use during foot and ankle surgery. Devereaux et al (8) found that major bleeding was more common in the aspirin group than in the placebo group (230 patients [4.6%] versus 188 patients [3.8%]) in 10,010 patients at risk for vascular complications who randomly received aspirin or placebo and clonidine or placebo before noncardiac surgery. Based on that study, there was no increase in the rate of a composite of death and nonfatal myocardial infarction if aspirin was administered before surgery and continued during the early postoperative period. However, there was an increase in the risk of bleeding.

Of the 379 patients who underwent elective foot and ankle surgery, 3 (2 in the aspirin group and 1 in the no-aspirin group) had postoperative hematomas with the following findings: elevation and discoloration of the wound edges, discomfort, swelling, redness, wound dehiscence, and loosening of the sutures at week 2.

Neither consensus nor guidelines exist in the literature indicating that aspirin should or should not be discontinued preoperatively in foot and ankle surgery. In abdominal, cranial, and high-risk vascular surgeries, physicians recommend cessation of aspirin. Based on our findings, we believe that the physicians who terminate perioperative aspirin use before any foot and ankle surgery should allow their patients to continue taking aspirin because it may be more beneficial (prevention of a thromboembolic event and anticoagulant effects) than subjecting these patients to rebound effects, which could be detrimental.

Effectively, we could argue that there was not enough statistical evidence at the 95% confidence level that the occurrence of hematoma was independent of aspirin use, and the occurrence was rather coincidental and could be best explained by other factors. We investigated other explanatory factors, namely, age, sex, foot type, type of surgery, diabetic condition, statin therapy status, and presence of other comorbidities.

In our study, no correlation between aspirin use and postoperative hematoma formation was noted. Considering that there were only 3 cases of postoperative hematoma, which is a very small number, we are uncertain whether our *p* value was significant. In these cases, the surgical sites were allowed to close by secondary intention, and those patients were followed every week for wound care. All 3 patients achieved wound closure in week 5 after their surgical date.

Table 2
Test for normality

Factor	Kolmogorov-Smirnov Test*			Shapiro-Wilk Test		
	Statistic	Degrees of Freedom	Significance	Statistic	Degrees of Freedom	Significance
Hematoma/bleeding complications	.528	379	.000	.061	379	.000
Diabetes	.349	379	.000	.636	379	.000
On statin therapy	.383	379	.000	.627	379	.000
Other comorbidities	.158	379	.000	.960	379	.000

* Lilliefors significance correction. Transfusion and reoperation are constant.

Table 3
Fisher's exact test

Factor	Value	Degrees of Freedom	Asymptotic Significance (2-Sided)	Exact Significance (2-Sided)	Exact Significance (1-Sided)
Pearson chi-square	.019*	1	.889		
Continuity correction†	.000	1	1.000		
Likelihood ratio	.020	1	.888		
Fisher's exact test				1.000	.688
Linear-by-linear association	.019	1	.889		
No. of valid cases	379				

* Two cells (50.0%) have an expected count of <5. The minimum expected count is 1.12.
† Computed only for a 2 × 2 table.

To the best of our knowledge, this was the first retrospective study to investigate hematoma formation owing to aspirin use in the perioperative period of foot and ankle surgery. None of our patients was instructed to voluntarily stop taking aspirin 3 to 7 days before surgery. Most patients had risk factors for developing cardiovascular disease, but it was unclear how many of the patients were taking aspirin for the secondary prevention of cardiovascular events. It was difficult to understand the effects of bleeding and the rebound effects of aspirin cessation in those patients.

There could be many reasons for the formation of the hematomas in those patients. All 3 patients reported walking during the postoperative period despite the recommendation to be non-weightbearing and to remain in a below-the-knee cast for 4 to 6 weeks. In addition, all 3 patients had poor glycemic control (mean fasting blood sugar >200 mg/dL postoperatively; range 200 to 210 mg/dL). Hyperglycemia may lead to surgical wound dehiscence and poor healing (9), because diabetic patients generally have cellular dysfunction and prolonged inflammatory conditions that impede wound healing (10,11).

This study has some limitations. The number of patients who developed hematoma and who were smokers and alcohol users was unknown. Smoking reduces bone and soft tissue healing potential by decreasing the oxygen-carrying capacity of the hemoglobin and inhibiting the metabolism of oxidative energy at the cellular level (12). Excessive alcohol intake leads to poor wound healing and problems with hemostasis (13). It was unclear if the patients had osteopenia or vitamin D deficiencies before surgery. 1,25-Dihydroxyvitamin D3 regulates the expression of antimicrobial proteins that mediate innate immunity in the skin, which promotes wound healing and tissue repair (14,15). Adequate diet and serum albumin levels play a large role in wound healing (16); however, whether patients practiced heavy lifting or had recurrent vomiting, coughing, or an improper diet was uncertain. The dietary intake or nutritional status (before or after the surgical period) of the 3 patients was not investigated (17), and such factors affect surgical wound dehiscence. The body mass indices of the patients were not considered. Generally, patients who are obese have more postoperative complications and morbidities than their nonobese counterparts (18). Whether the patients who claimed to have been on aspirin therapy before surgery were taking it as prescribed was not confirmed, because it is highly likely that the primary care physician had ordered them to stop taking aspirin during their preoperative consultation. In addition, the preoperative nurse may have advised the patients to discontinue aspirin before surgery. Hence, it was unclear if the overall complications in the study were solely caused by aspirin.

In conclusion, our study has shown no correlation between surgical complications with elective foot and ankle surgery and aspirin use. In our large sample size (379 patients), many patients were on aspirin, and only a small percentage of patients had postoperative wound complications. Based on our results, discontinuation of aspirin before any foot and ankle surgery may not be warranted.

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