Preoperative Antiplatelet Therapy Does Not Increase the Risk of Spinal Hematoma Associated with Regional Anesthesia

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One thousand orthopedic procedures in 924 patients given spinal or epidural anesthesia were prospectively studied to determine the risk of hemorrhagic complications associated with regional anesthesia. A history of excessive bruising or bleeding was elicited in 115 (12%) patients. Preoperative antiplatelet medications were taken by 386 (39%) patients. Aspirin was the most frequently reported antiplatelet drug and was taken by 193 patients. Subcutaneous heparin was administered to 22 patients before surgery on the operative day. One patient of 774 tested had a preoperative platelet count less than 100,000/mm.^{3} In addition, 26 of 171 preoperative prothrombin times and 10 of 115 preoperative activated partial thromboplastin times were longer than normal. Only 31 preoperative bleeding times were performed; five were prolonged. There were no documented spinal hematomas (major hemorrhagic complications). Blood was noted during needle or catheter placement (minor hemorrhagic complication) in 223 (22%) patients, including 73 patients with frank blood in the needle or catheter. Preoperative antiplatelet therapy did not increase the incidence of minor hemorrhagic complications. However, female gender, increased age, a history of excessive bruising/bleeding, surgery to the hip, continuous catheter anesthetic technique, large needle gauge, multiple needle passes, and moderate or difficult needle placement were all significant risk factors. The lack of correlation between antiplatelet medications and bloody needle or catheter placement (producing clinically insignificant collections of blood in the spinal canal or epidural space) is strong evidence that preoperative antiplatelet therapy is not a significant risk factor for the development of neurologic dysfunction from spinal hematoma in patients who undergo spinal or epidural anesthesia while receiving these medications.

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Although hemorrhagic complications can occur after virtually all regional anesthetic techniques, bleeding into the spinal canal is perhaps the most serious hemorrhagic complication associated with regional anesthesia because the spinal canal is a concealed and nonexpandable space. Spinal cord compression from spinal hematoma may result in neurologic ischemia and paraplegia. Although the actual incidence of clinically significant spinal hematoma associated with spinal or epidural anesthesia is unknown, the incidence cited in the literature is less than 1 in 10,000 procedures (1–3).

In a previous retrospective study, we reviewed 1013 spinal and epidural anesthetics in which preoperative antiplatelet medications were taken by 391 (39%) patients, including 113 (11%) patients receiving multiple antiplatelet drugs (4). No patient developed signs of spinal hematoma. However, patients receiving antiplatelet therapy exhibited a higher incidence of minor hemorrhagic events (blood aspirated through the spinal or epidural needle or catheter). In addition, increased age and an epidural (but not a spinal) anesthetic technique, when occurring simultaneously, were also associated with an increase in the incidence of minor hemorrhagic complications. These results suggested predisposing variables, such as preoperative antiplatelet therapy, age, and anesthetic technique, might be predictive of minor hemorrhagic complications. Aspiration of blood through the spinal or epidural needle may not imply an increased risk for spinal hematoma. However, in 62% of spinal hematomas occurring after lumbar puncture reviewed by Owens et al. (5), the needle placement was described

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as difficult and/or bloody. The retrospective nature of the study makes interpretation of the results difficult. The presence of a small amount of blood in a spinal or epidural needle or catheter may not always be reported on the anesthesia record; therefore the actual incidence of minor hemorrhagic events may have been underestimated. Likewise, our anesthesia record provides limited information on needle approach, number of needle passes, and needle placement difficulty.

Because of the limitations of retrospective data analysis, particularly in view of the implications of antiplatelet medications as a risk factor for minor hemorrhagic complications, we thought it important to verify the results prospectively. This study prospectively examines the risk of spinal hematoma associated with spinal or epidural anesthesia in patients receiving preoperative antiplatelet medications. It also identifies risk factors associated with an increased incidence of minor hemorrhagic complications during spinal or epidural needle and catheter placement.

Methods

After approval by our institution's review board, 1000 orthopedic procedures performed under spinal or epidural anesthesia in 924 patients were studied prospectively. Demographic data including age, gender, date of surgery, and type of surgery were recorded. Preoperative coagulation tests such as platelet count, activated partial thromboplastin time (aPTT), prothrombin time (PT), and bleeding time were also recorded. All patients were questioned preoperatively about a history of excessive bruising or bleeding and the use of antiplatelet medications in the week prior to surgery. Preoperative antiplatelet therapy was defined as aspirin 1 wk prior to surgery or any other nonsteroidal antiinflammatory drug such as ibuprofen, naproxen, piroxicam, and diclofenac 3 days prior to surgery. Anesthetic technique (spinal or epidural, single dose or continuous catheter), needle gauge, approach (midline, paramedian, or both), and duration of an indwelling epidural catheter (if used) was noted. The presence of blood or blood-tinged fluid during needle or catheter placement (minor hemorrhagic event) was noted. Bleeding from obvious trauma to soft tissue was not included. The spinal or epidural catheter tip was also examined for the presence of blood at the time of removal. Needle placement difficulty was graded from 1 to 4 (1 = easy, or 1–5 needle passes; 2 = moderate, or 6–10 needle passes; 3 = difficult, more than 10 needle passes, additional needle approaches or anesthesia personnel used; 4 = abandon regional anesthetic technique). The number of needle passes made by the resident and/or consultant anesthesiologist were recorded. (A needle pass was defined as any readjustment of the needle position that would result in an additional needle tract.) Spinal and epidural anesthetics were observed or performed by one of the investigators. Intraoperative blood loss and perioperative transfusion of blood products were recorded for patients undergoing revision hip and bilateral total knee arthroplasties. The use of postoperative antiplatelet or anticoagulant medications was also noted.

Patients were followed until hospital dismissal and observed for evidence of spinal cord compression such as radicular back pain or progressive neurologic deficits. The hospital records were also reviewed 6 mo after hospital dismissal for subsequent admissions or complaints resulting from possible neurologic sequelae.

Both univariate and multivariate statistical analyses were performed. Gender, procedure type, preoperative use of antiplatelet drugs, history of excessive bruising or bleeding, anesthetic technique, needle gauge and approach, level of expertise of the physician (resident or consultant) attempting needle placement, and needle placement difficulty were analyzed univariately using a χ^2 analysis. Age and total number of needle placements were analyzed using the rank sum test and χ^2 analysis. Coagulation tests, estimated blood loss, and transfusion requirements were analyzed using the rank sum test. In all analyses, two-sided tests were used with $P \leq 0.05$ considered statistically significant.

A multivariate logistic regression analysis was used to identify variables associated with the occurrence of minor hemorrhagic complications. Dichotomous variables were created for each procedure type, needle approach, physician experience, and anesthetic technique. An ordinal variable was used for assessing needle placement difficulty (1 = easy, 2 = moderate, 3 = difficult/abandon regional anesthetic technique). Other predictor variables included were gender, age, history of bruising, and total number of needle passes. The logistic regression analysis was performed using backward elimination of the nonsignificant variables. $P \leq 0.05$ was considered statistically significant.

Results

The average age was 57 ± 20 yr (range 13–107 yr). There were 511 (51%) surgical procedures performed on males and 489 (49%) on females. Surgical procedures included 287 hip (excluding revision hip arthroplasty), 41 revision hip arthroplasty, 451 unilateral knee, 50 bilateral knee arthroplasty, 80 ankle, 13 foot, and 78 other lower extremity procedures. Surgical procedures were performed over an 11-mo period from July 1992 to June 1993.

A history of excessive bruising or bleeding was elicited in 115 (12%) patients. Antiplatelet medications

Table 1. Preoperative Antiplatelet and Anticoagulant Therapy

Medication	*n*	Daily dose (mg)		Patients with minor hemorrhagic complications		
		Median	Range	*n*	%	*P*[a]
Antiplatelet drug (mg)						
Aspirin	193	350	60–4800	47	24.4	NS
Ibuprofen	70	800	200–3200	17	24.3	NS
Naproxen	48	1000	250–1125	12	25.0	NS
Diclofenac	28	150	50–225	4	14.3	NS
Piroxicam	14	20	10–75	3	21.4	NS
Dipyridamole	13	150	75–225	4	30.8	NS
Indomethacin	11	100	50–500	4	36.4	NS
Sulindac	8	300	200–400	0	0.0	NS
Ketorolac	8	60	30–99	2	25.0	NS
Other	25			8	32.0	NS
Anticoagulant (U)						
Heparin	25	10000	5000–28000	9	36.0	NS

NS = not significant ($P > 0.05$).
[a] χ^2 test comparing patients receiving the specific antiplatelet drug versus patients not receiving the drug on the basis of the percent experiencing minor hemorrhagic complications.

were taken preoperatively by 386 (39%) patients, including 32 patients on multiple antiplatelet medications. Aspirin was the most frequently used antiplatelet drug and was taken by 193 patients. Other commonly reported antiplatelet drugs included ibuprofen, naproxen, and diclofenac. In addition, 25 patients received heparin before surgery on the operative day, including 22 patients who were administered subcutaneous heparin. No patient had received warfarin within 48 h of surgery. Preoperative antiplatelet and anticoagulant medications and their total daily doses are listed in Table 1.

Platelet counts were obtained preoperatively in 774 patients (mean 277,000 ± 84,000), including one patient with a platelet count of 94,000/mm.^{3} The PT was slightly increased in 26 of 171 patients tested. However, no value was above 15.5 (normal 10.9–12.8 seconds). Ten of the 115 preoperative aPTTs were prolonged; nine were between 37 and 56 (normal 23–37 s), one was increased to 78.8 s. Preoperative bleeding time was prolonged in five of 31 patients tested (normal 1.5–8.0 min).

Needle placement was accomplished with a 17- or 18-gauge needle in 644 cases (17 single-dose epidural, 575 continuous epidural, 46 continuous spinal, and 6 single-dose spinal anesthetics). Of the remaining 356 single-dose spinal anesthetics, one was performed with a 20-gauge needle, 257 with a 22-gauge needle, 82 with a 25-gauge needle, and 16 with a 26-gauge needle. Needle approach was midline in 789 patients, paramedian in 149 patients, and both approaches were used in 62 patients. In 381 (38%) patients, satisfactory needle placement was obtained with one pass, 318 (32%) patients required two to three passes, while the remaining 301 (30%) patients required four or more passes. Needle placement was described as easy in 722 (72%), moderately difficult in 213 (21%), and difficult in 56 (6%) patients. In nine patients, satisfactory needle placement was not achieved and general anesthesia was induced. The needle was successfully placed by a resident in 568 (57%) patients and by a consultant in 304 (30%) patients. In addition, there were 128 (13%) patients in which a resident attempted needle placement unsuccessfully and a consultant performed the spinal or epidural block. Paresthesias were elicited during needle placement in 56 patients and during catheter placement in 124 patients.

No patient developed signs or symptoms of spinal hematoma. Blood was present in the spinal or epidural needle or catheter in 223 (22%) patients; in 73 patients the blood was frank, while in the remaining 150 patients the blood was diluted with cerebrospinal fluid or local anesthetic. Preoperative antiplatelet therapy did not increase the incidence of minor hemorrhagic complications associated with spinal or epidural anesthesia. No specific antiplatelet medication was a significant risk factor for minor hemorrhagic complications. However, patient and anesthetic factors such as female gender, age greater than 65 yr, a history of excessive bruising or bleeding, surgery to the hip, regional anesthetic technique (continuous spinal > continuous epidural > single-dose spinal), large needle gauge, multiple needle passes, and moderate or difficult needle placement were all significant risk factors ($P < 0.05$). In addition, while there was no difference in the incidence of minor hemorrhagic complications between midline or paramedian approaches, the need to use both approaches was a significant risk factor ($P < 0.05$). Likewise, level of anesthetic training (resident or consultant) was not significant unless needle passes by both the resident and the consultant were required to place the needle

Table 2. Patient Factors Associated with Minor Hemorrhagic Complications

Factor	No. of procedures	Patients with minor hemorrhagic complications		χ^2 test
		n	%	*P*
Gender				0.034
Male	511	100	19.6	
Female	489	123	25.1	
Age				0.035
<65 yr	533	105	19.7	
≥65 yr	467	118	25.2	
Surgical procedure[a]				0.002
Hip	287	87	30.3	
Other	713	136	19.1	
Antiplatelet medication				NS
Yes	386	88	22.8	
No	614	135	22.0	
History of bruising				0.014
Yes	115	36	31.3	
No	885	187	21.1	

NS = not significant ($P > 0.05$).
[a] *P* values are for comparing hip, revision hip arthroplasty, knee, bilateral total knee arthroplasty, and ankle surgical procedures.

($P < 0.05$). Patient and anesthetic risk factors associated with minor hemorrhagic complications identified by univariate analysis are listed in Tables 2 and 3. Multivariate analysis identified surgery to the hip and needle placement difficulty as independent risk factors (Fig. 1). There was no difference in preoperative platelet counts, PTs, aPTTs, or bleeding times between the patients with and without minor hemorrhagic complications (Table 4).

Estimated blood loss and perioperative transfusion requirements in patients undergoing bilateral total knee arthroplasty tended to be greater in patients who had received preoperative antiplatelet medications, although these results are not significant. However, patients who received antiplatelet therapy and subsequently underwent revision hip arthroplasty lost significantly more blood (1790 ± 1344 mL) and required more postoperative blood transfusions (1.2 ± 0.9 units) than patients who did not receive these medications, whose recorded blood loss and postoperative blood transfusions were 954 ± 605 mL and 0.6 ± 0.4 units, respectively ($P < 0.05$).

Epidural catheters were left indwelling postoperatively in 131 patients. Of these, 76 had an epidural catheter indwelling for 1 day, 43 for 2 days, 10 for 3 days, 1 for 4 days, and 1 for 5 days. The epidural catheter tip was examined at the time of removal in 365 patients; blood was present in 180 (49%) patients. Patients with blood present during catheter placement were more likely to have blood present at the time of catheter removal ($P < 0.05$). However, preoperative antiplatelet therapy did not increase the incidence of blood present in the catheter tip at the time of removal.

Data regarding postoperative use of anticoagulants or antiplatelet medications was available for 883 patients. Of these, 716 (81%) received antiplatelet or anticoagulant therapy.

No patient developed a central nervous system complication such as arachnoiditis or cauda equina syndrome. Seven patients developed a postdural puncture headache requiring epidural blood patch. There were seven cases (in five patients) of postoperative peripheral neuropathy unrelated to needle or catheter placement, two persistent paresthesias (one of which was associated with a paresthesia during needle placement), and three postoperative cerebrovascular accidents. There were also two postoperative deaths unrelated to anesthesia.

Discussion

Orthopedic patients undergoing major joint surgery often have chronic musculoskeletal pain or underlying inflammatory diseases such as rheumatoid arthritis and are frequently medicated with nonsteroidal antiinflammatory drugs preoperatively. Preoperative use of antiplatelet medications, including such medications as aspirin, naproxen, ibuprofen, and ketorolac, has been considered a relative contraindication to spinal or epidural anesthesia by some anesthesiologists due to the associated prolongation of the bleeding time and theoretical greater risk of spinal hematoma formation.

Antiplatelet medications inhibit platelet cyclooxygenase and prevent the synthesis of thromboxane A_2. Thromboxane A_2 is not only a potent vasoconstrictor, but also facilitates secondary platelet aggregation and release reactions. Platelets from patients who have been taking these medications have normal platelet adherence to subendothelium and normal primary hemostatic plug formation. Thus an adequate, although potentially fragile, clot may form. Although such plugs may be satisfactory hemostatic barriers for smaller vascular lesions, they may not ensure adequate perioperative hemostatic clot formation.

It has been suggested that the Ivy bleeding time is the most reliable predictor of abnormal bleeding in patients receiving antiplatelet drugs (6). However, the "postaspirin" bleeding time is not a reliable indicator of platelet function, recent antiplatelet therapy, or surgical blood loss (7–10). Although the bleeding time may quickly normalize after aspirin ingestion, platelet function as measured by platelet response to adenosine diphosphate or epinephrine may take up to a

Table 3. Anesthetic Factors Associated with Minor Hemorrhagic Complications

Factor	No. of procedures	Patients with minor hemorrhagic complications		χ^2 test P
		n	%	
Regional anesthetic technique[a,b]				0.001
Epidural, single-dose	17	3	17.6	
Spinal, single-dose	362	64	17.8	
Epidural, continuous	575	138	24.0	
Spinal, continuous	46	18	39.1	
Needle gauge[b]				0.021
<22	98	13	13.3	
22 (including one 20)	258	51	19.8	
18 (including one 17)	644	159	24.7	
Total needle passes[b]				<0.001
1	381	55	14.4	
2–3	318	69	21.7	
>3	301.	99	32.9	
Needle placement difficulty[b,c]				<0.001
Easy	722	127	17.6	
Moderate	213	63	29.6	
Difficult	56	27	48.2	
Abandon regional technique	9	6	66.7	
Needle approach[d]				0.035
Midline	789	168	21.3	
Paramedian	149	33	21.1	
Both	62	22	35.5	
Needle placed by[d]				0.004
Resident	568	115	20.2	
Consultant	304	65	21.4	
Both	128	43	33.6	

[a] P values are for comparing regional anesthetic techniques of continuous spinal, epidural, and continuous epidural.
[b] Listed in increasing risk for minor hemorrhagic complications. All pair-wise comparisons within category are found to be significant.
[c] P values are for needle placement grading of easy, moderate, and difficult.
[d] Only "both" was significant in this category.

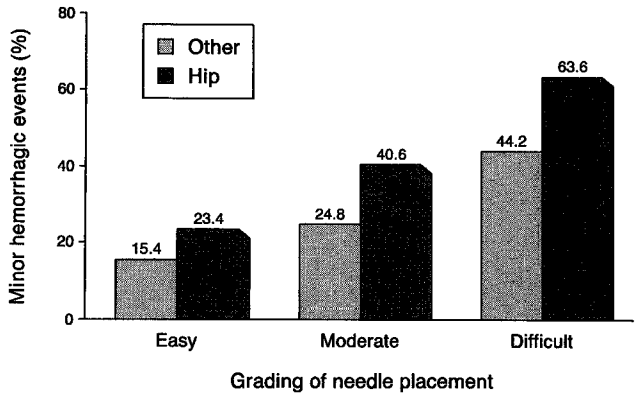

Figure 1. Risk profile for minor hemorrhagic complications identified using multivariate analysis. Surgery to the hip and moderate or difficult needle placement increase the incidence of minor hemorrhagic complications. Hip = primary surgical procedure to the hip; Other = all other lower extremity surgical procedures.

week to return to normal. Other antiplatelet medications (naproxen, piroxicam, ibuprofen) produce a short-term defect which normalizes within 3 days (11). Therefore, measurement of an Ivy bleeding time before induction of spinal or epidural anesthesia is clinically not indicated. Platelet function in patients receiving antiplatelet therapy should be assumed to be decreased for 1 wk with aspirin and 3 days with other antiplatelet drugs. Special platelet function assays are available to monitor platelet aggregation and reversal of the "antiplatelet" effect. However, these are expensive and not readily available for routine clinical use.

Our study demonstrated increased blood loss and transfusion requirements in patients receiving antiplatelet medications who subsequently undergo revision hip arthroplasty, an extensive and prolonged surgical procedure performed without a tourniquet. However, there was no correlation between preoperative antiplatelet therapy and the presence of blood in spinal or epidural catheters during either placement or removal, suggesting that the trauma incurred during needle or catheter placement is neither increased nor sustained by these medications.

The risk of spinal hematoma associated with administration of spinal or epidural anesthesia to a patient receiving preoperative antiplatelet medications

Table 4. Age and Coagulation Tests in Patients With and Without Minor Hemorrhagic Complications

	Without minor hemorrhagic complications			With minor hemorrhagic complications			Rank sum test
	n	Mean ± SD	Range	*n*	Mean ± SD	Range	*P*
Age (yr)	777	56 ± 20	13–94	223	61 ± 19	16–107	0.006
Platelet count ($\times 10^3$)	587	279 ± 87	107–739	187	271.9 ± 79.5	94–669	NS
PT (s)	121	12.0 ± 1.1	8.9–15.5	50	12.0 ± 0.7	9.8–13.2	NS
aPTT (s)	78	31.0 ± 8.4	22.2–78.8	37	28.8 ± 2.9	22.1–36.8	NS
Bleeding time (min)	21	5.3 ± 2.5	1.5–12.0	10	6.9 ± 4.1	2.0–12.9	NS

NS = not significant ($P > 0.05$); PT = prothrombin time; aPTT = activated partial thromboplastin time.
Normal range of PT, 10.9–12.8 s; aPTT, 23–37 s; and bleeding time, 1.8–8.0 min.

remains controversial and largely unstudied. A literature review by Owens et al. (5) implicated antiplatelet therapy in 2 of the 34 cases of spinal hematoma occurring after attempted lumbar puncture. One patient received ticlopidine (a drug with antiplatelet effects) preoperatively, while one patient received postoperative aspirin (2,12). There has also been a single reported case of spontaneous epidural hematoma formation (in the absence of spinal or epidural anesthesia) in a patient with a history of excessive aspirin ingestion (13).

Our study does not implicate antiplatelet medications as a risk factor for minor hemorrhagic events with spinal or epidural needle or catheter placement. These results most likely differ from those of our retrospective study due to the increased accuracy in reporting minor hemorrhagic events using the prospective approach. The higher incidence of minor hemorrhagic events in our current study (22%) compared to our retrospective study (2%) suggests that the presence of blood during needle or catheter placement may not always be recorded on the anesthesia record.

As with our retrospective study, multiple patient and anesthetic variables were again identified as significant risk factors for the development of minor hemorrhagic events. However, some of the variables identified prospectively, such as total number of needle passes and needle placement difficulty, are clearly interdependent. Needle placement difficulty is an assessment which incorporates not only the total number of needle passes, but also the need to use additional anesthesia personnel or needle approaches. Surgery to the hip is an independent variable most likely because this group includes patients with hip fractures who have increased age and are generally in poor medical condition.

Although there were no documented spinal hematomas with neurologic dysfunction in our study, it is important to note that even in a large study, the finding of zero events does not imply the risk is zero in the whole population. The absence of spinal hematoma in the 386 patients who received preoperative antiplatelet therapy and subsequent spinal or epidural anesthesia places the maximum risk (with 95% confidence using Poisson approximation) at 1.1%. However, the lack of correlation between antiplatelet drugs and minor hemorrhagic events (producing clinically insignificant collections of blood in the spinal canal or epidural space) is strong evidence that preoperative antiplatelet therapy is not a significant risk factor for the development of spinal hematoma in patients who undergo spinal or epidural anesthesia while receiving these medications.

The decision to perform spinal or epidural anesthesia should be made on an individual basis, weighing the risk of spinal hematoma with the benefits of regional anesthesia for a specific patient. Patients considered high-risk should be monitored closely in the perioperative period for early signs of cord compression such as radiating back pain, meningismus, or neurologic dysfunction. If spinal hematoma is suspected, immediate radiologic and neurosurgical evaluation should be performed. Recovery is unlikely if surgery is postponed for more than 12 h (14).

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