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Health Policy Review

Assessment of Practice Patterns of Perioperative Management of Antiplatelet and Anticoagulant Therapy in Interventional Pain Management

Laxmaiah Manchikanti, MD[1], Ramsin M. Benyamin, MD[2], John R. Swicegood, MD[3], Frank J.E. Falco, MD[4], Sukdeb Datta, MD[5], Vidyasagar Pampati, MSc[6], Bert Fellows, MA[7], and Joshua A. Hirsch, MD[8]

From: [1,6,7] Pain Management Center of Paducah, Paducah, KY, and [1] University of Louisville, Louisville, KY; [2] Millennium Pain Center, Bloomington, IL, and University of Illinois, Urbana-Champaign, IL; [3] Advanced Interventional Pain And Diagnostics Of Western Arkansas, Fort Smith, AR; [4]Mid Atlantic Spine & Pain Physicians of Newark, Newark, DE, and Temple University Hospital, Philadelphia, PA; [5]Laser Spine & Pain Institute, and Mount Sinai School of Medicine, New York, NY; and [8] Massachusetts General Hospital, and Harvard Medical School, Boston, MA.

Additional Author Affiliation inforamtion and Conflicts of Interest are on Page E964.

Address correspondence: Laxmaiah Manchikanti, M.D. 2831 Lone Oak Road Paducah, Kentucky 42003 E-mail: drlm@thepainmd.com

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Background: The role of antithrombotic therapy is well known for its primary and secondary prevention of cardiovascular disease by decreasing the incidence of acute cerebral, cardiovascular, peripheral vascular, and other thrombotic events. The overwhelming data show that the risk of thrombotic events is significantly higher than that of bleeding during surgery after antiplatelet drug discontinuation. It has been assumed that discontinuing antiplatelet therapy prior to performing interventional pain management techniques is a common practice, even though doing so may potentially increase the risk of acute cerebral and cardiovascular events. There are no data available concerning these events, specifically in relation to the occurrence of thromboembolic events, even though some data are available concerning bleeding complications. Even then, interventionalists seem to routinely discontinue all antithrombotic therapy prior to all interventional pain management techniques.

Objective: To assess the perioperative antiplatelet and anticoagulant practice patterns of US interventional pain management physicians as well as adverse events in patients on antithrombotic therapy who undergo interventional pain management techniques when that therapy is continued or stopped.

Study Design: An online survey of interventional pain management physicians.

Study Setting: Interventional pain management practices in the United States.

Methods: An online survey was commissioned among 2,300 members of the American Society of Interventional Pain Physicians. The survey was designed to assess practice patterns and complications encountered.

Results: Of the 2,300 members surveyed, 325 responded. These results showed that all physicians discontinued warfarin therapy; whereas, 97% discontinued clopidogrel; 96% ticlopidine; 95% Aggrastat (tirofiban); 93% cilostazol, 85% dipyridamole, 60% aspirin 350 mg; 39% aspirin 81 mg; and 39% other nonsteroidal anti-inflammatory drugs (NSAIDs) prior to performing interventional pain management techniques. The majority of physicians accepted an international normalized ratio of 1.5 or less as a safe level.

An assessment of serious complications showed thromboembolic events were 3 times more frequent than bleeding complications: 162 thromboembolic events and 55 serious bleeding complications from epidural hematomas. Thromboembolic complications were severe and higher when antiplatelet therapy was discontinued. Bleeding complications from epidural hematomas were similar whether antiplatelet therapy was continued or discontinued (26 versus 29).

Limitations: This study was limited by its being an online survey of the membership of one organization in one country and that there was a 14% response rate. Underreporting in surveys is common. Further, the incidence of thromboembolic events or epidural hematomas may be misrepresented as a percentage since these drugs were continued in a very small percentage of patients. Consequently, the incidences described in this manuscript may not show appropriate percentages.

Conclusion: The results illustrate an overwhelming pattern of discontinuing antiplatelet and warfarin therapy as well as aspirin and other NSAIDs prior to performing interventional pain management techniques. However, thromboembolism complications may be 3 times more prevalent than epidural hematomas (162 versus 55 events). It is concluded that clinicians must balance the risks of thromboembolism and bleeding in each patient prior to the routine discontinuation of antiplatelet therapy.

Key words: Interventional pain management, interventional techniques, hemostasis, anticoagulants, antiplatelet therapy, thromboembolic events, bleeding, complications, aspirin, clopidogrel (Plavix), warfarin (Coumadin).

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In modern medical practice, antithrombotic therapy to prevent cardiovascular, cerebrovascular, peripheral vascular, and other thromboembolic events (1-5), and interventional pain management techniques to improve functional impairment in chronic, persistent pain, have been used extensively (6-22). It has been estimated that approximately 25% of the patients presenting for interventional pain management techniques are on antithrombotic therapy (23,24). In addition, it also has been shown that approximately 5% of the patients who have undergone percutaneous coronary interventions will undergo noncardiac surgery within the first year after stenting; this proportion may be higher for patients undergoing interventional pain management techniques (25,26). Physicians managing such patients are confronted with the complex issue of risking hemorrhagic complications when continuing antiplatelet agent therapy in the perioperative period, or facing the risk of cerebral, cardiac, peripheral vascular, or other thrombotic events if the drugs are discontinued abruptly (27-32). Traditionally, interventional pain management physicians have discontinued such medication 10 days before an intervention, which may pose considerable danger (24,33-44). This information in multiple guidelines is derived from case reports (33-44). The incidence of epidural hematoma of less than one per 150,000 epidural anesthetics and less than one of 220 spinal anesthetics for surgical cases has been widely reported (33-44). However, no such estimations are available for interventional pain management techniques. On the other hand, acute withdrawal of antiplatelet agents produces a deleterious rebound effect (26-32,45,46).

The evidence of bleeding risk during interventional pain management techniques in patients undergoing antiplatelet therapy is scant to nonexistent (23,24,47,48). There have been multiple reports related to regional anesthesia for surgical procedures and interventional pain management techniques for chronic pain (49-55).In addition, the validity of consensus guidelines developed by the American Society of Regional Anesthesia and the evidence to remove epidural catheters below an international normalized ratio (INR) of 1.5 has been questioned (56) based on various issues related to warfarin (57). Instances of bleeding have been reported with or without antithrombotic therapy and whether the therapy was continued or discontinued (23,24,47-55,58-62).

Outpacing the risk of intraoperative hemorrhage, a systematic review and meta-analysis of the hazards of discontinuing or not adhering to aspirin therapy among patients at risk for coronary artery disease showed an ominous prognosis (31). A study evaluating the incidence of death and acute myocardial infarction associated with discontinuing clopidogrel (Plavix) after acute coronary artery syndrome (4) showed a cluster of adverse events in the initial 90 days after discontinuing clopidogrel. These adverse events happened to both medically treated and percutaneous coronary intervention treated patients with acute coronary syndrome, supporting the possibility of a clopidogrel rebound effect. In fact, even for interventional pain management techniques, thromboembolic stroke has been reported from an epidural steroid injection (63).

In contrast to regional anesthesia guidelines, which have been extrapolated to interventional pain management therapy, multiple other disciplines, including peripheral vascular surgery, ophthalmology, and gastroenterology, have advocated continuing antiplatelet therapy. (26,64-69). In a systematic review of the perioperative management of patients receiving oral antithrombotics (65), it was concluded that most patients can undergo dental procedures, arthrocentesis, cataract surgery, and diagnostic endoscopy without alteration of their regimen. Chassot et al (26), in a manuscript on perioperative antiplatelet therapy, described that because of the hypercoagulable state induced by surgery, early withdrawal of antiplatelet therapy for the second-

ary prevention of cardiovascular disease increases the risk of postoperative myocardial infarction and death 5 to 10-fold in stented patients who where on continuous dual antiplatelet therapy. In addition, they also added that the risk of surgical hemorrhage was increased approximately 20% by aspirin or clopidogrel alone, and 50% by dual antiplatelet therapy, even though serious complications were not reported. In Chassot et al's manuscript published in 2010 (26), they concluded that the risk of a cardiovascular event when antiplatelet therapy is discontinued preoperatively is higher than the risk of surgical bleeding when continuing these drugs, except during surgery in a closed space such as intracranial, posterior eye chamber, or surgeries associated with massive bleeding and difficult hemostasis. Shuler et al (68) also recommended as early as 1992 that except for low-risk patients for thromboembolic events, the practice of withdrawing antiplatelet drugs 5 to 10 days prior to surgical procedures should be changed. It was shown that phacoemulsification and posterior chamber intraocular lens implantation can be performed without serious complications in patients who continued antiplatelet therapy (64). Recent assessments of ophthalmic surgery, peripheral vascular surgery, and endoscopic procedures (66-69) also echoed the above conclusions.

Only a few studies have evaluated bleeding risk in patients undergoing active antiplatelet therapy during regional anesthesia (47,48) and interventional pain management techniques (23,24). Among these, Manchikanti et al (23), analyzed over 10,000 encounters and over 18,000 procedures. One-quarter of the patients were on antiplatelet therapy; some of them continued with the therapy and others discontinued it. There was no significant difference between these patients and those who were not on antiplatelet therapy. Further, no major complications were noted in any of the groups. Horlocker et al (47) analyzed 1,000 orthopedic procedures in 924 patients given spinal or epidural anesthesia. They concluded that there was no correlation between antiplatelet medication and bloody needle or catheter placement producing clinically significant collections of blood in the spinal canal or epidural space. They also concluded that antiplatelet therapy was not a significant risk factor for developing neurologic dysfunction from spinal hematoma in patients who undergo spinal or epidural anesthesia while receiving these medications. Horlocker et al (48), in another retrospective review of 805 patients given 1,013 spinal or epidural anesthetics, showed that epidural injections in the elderly are associated with a 4.5% incidence of minor hemorrhagic complications and the ability to aspirate blood in the needle. In another study, Horlocker et al (24), assessed the risk of hemorrhagic complications associated with nonsteroidal anti-inflammatory drugs (NSAIDS), including aspirin, in ambulatory pain clinic patients undergoing epidural steroid injections. They looked at 1,035 individuals undergoing 1,214 epidural steroid injections, and reported no spinal hematomas or major hemorrhagic complications. In addition, they also concluded that NSAIDS, including aspirin, did not increase the frequency of minor hemorrhagic complications due to the onset of neurological symptoms in 42 patients, or worsening of the pre-existing complaints that persisted more than 24 hours after the injection with a median duration of symptoms of 3 days and a range from one to 20 days.

Even with the paucity of evidence and highly variable and non-evidence-based guidelines, it appears that practitioners continue to routinely withhold antiplatelet therapy prior to interventional pain management techniques. Consequently, this national survey of contemporary interventional pain management practices was undertaken in the US to assess the perioperative management practice patterns of antiplatelet and anticoagulant therapy.

Methods

An online physician survey of antithrombotics use in interventional pain management was designed. The survey incorporated various aspects of practices, including: practice setting; limits on (INR when patients were on warfarin; practice patterns on discontinuing antithrombotic or related agents, such as aspirin and other agents; routine practices on stopping warfarin; experience with complications when antiplatelet therapy was continued or discontinued; any testing utilized for assessment of antiplatelet therapy; and finally, the total number of procedures performed per year and the number of years in practice. Table 1 shows the questionnaire. Responders were able to submit the data either electronically or manually.

A list of 2,300 interventional pain management physicians was obtained from the American Society of Interventional Pain Physicians. The online survey was e-mailed to physicians every 2 weeks on 3 occasions until responses were completed. A final questionnaire was sent to those who had not responded previously. The survey was carried out from August 24, 2012, through October 8, 2012.

Table 1. *List of items in questionnaire.*

1. What is your practice setting?
☐Office ☐ASC ☐Hospital ☐All settings

2. What are your limits on INR for:

Cervical/thoracic epidural	Less than _____	Shoulder	Less than _____
Lumbar interlaminar/transforaminal epidural	Less than _____	Stellate ganglion block	Less than _____
Caudal epidural	Less than _____	Lumbar sympathetic block	Less than _____
Cervical/thoracic facet joint injections	Less than _____	Hypogastric plexus block	Less than _____
Lumbar facet joint injections	Less than _____	Adhesiolysis	Less than _____
SI joint injections	Less than _____	Other blocks	Less than _____
Hip	Less than _____	Other injections	Less than _____

3. What is your routine on stopping Coumadin?
☐None ☐3 days ☐5 days ☐7 days ☐10 days ☐15 days ☐> 15 days

4. What is your philosophy and practice pattern on discontinuing antithrombotics or related agents?

	NSAIDS	Aspirin (81 mg)	Aspirin (350 mg)	Plavix (Clopidogrel)	Ticlid (Ticlopidine)	Dipyridamole (Persantine, Permole)	Pletal (Cilostazol)	Tirofiban (Aggrastat)	Abciximab (ReoPro)	Others: _____
None	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
3 days	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
5 days	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
7 days	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
10 days	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
15 days	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Over 15 days	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

5. Have you seen any complications **WHEN CONTINUED**?

	No	Yes	Number of Cases (+)	Drugs
Excessive bleeding with no adverse consequences	☐	☐	___	
Coronary artery infarct or event	☐	☐	___	
Cerebral infarct or event	☐	☐	___	
Peripheral vascular infarct				
Other	☐	☐	___	
Epidural hematoma				
Requiring only monitoring	☐	☐	___	
Without surgical intervention ***With*** significant neurological dysfunction	☐	☐	___	
With surgical intervention *Without* neurological dysfunction	☐	☐	___	
With surgical interventional ***With*** significant neurological dysfunction	☐	☐	___	

6. Have you seen any complications **WHEN DISCONTINUED**?

	No	Yes	Number of Cases (+)	Drugs
Excessive bleeding with no adverse consequences	☐	☐	___	
Coronary artery infarct or event	☐	☐	___	
Cerebral infarct or event	☐	☐	___	
Peripheral vascular infarct				
Epidural hematoma				
Requiring only monitoring	☐	☐	___	
Without surgical intervention ***With*** significant neurological dysfunction	☐	☐	___	
With surgical intervention *Without* neurological dysfunction			___	
With surgical interventional ***With*** significant neurological dysfunction			___	

7. **Total number procedures performed per year:** _____
Number of years in the practice: _____

8. Do you do any lab testing except INR for Coumadin? ☐ No ☐ Yes
If yes, what tests? _____

Results

The online survey was e-mailed to 2,300 physicians, and 325 responses were received, a 14% response rate.

Practice Settings

Most practice settings were in-office (118 or 36.3%); ASC only (28 or 8.6%); hospital only (36 or 11.1%); 21.5% practiced in 2 settings and 22.5% practiced in 3 settings. Of 325 physicians responded 278 (86%) were practicing more than five years and 237 (73%) of physicians were performing more than 1000 procedures per year.

Discontinuation of Warfarin

Table 2 illustrates the patterns of discontinuing warfarin prior to interventional pain management techniques. All discontinued warfarin prior to performing interventional pain management techniques. The majority (64%) discontinued it for 5 days, 17.3% discontinued it for ≤ 3 days, 16.7% discontinued it for 7 days, and approximately 2% discontinued it for over 10 days.

Table 2. *Patterns of discontinuing warfarin prior to interventional pain management techniques.*

	% (n)	Cumulative %
<= 3 days	17.3% (55)	17.3%
5 days	64.0% (203)	81.4%
7 days	16.7% (53)	98.1%
10 days	1.6% (5)	99.7%
15 days	0.3% (1)	100%
> 15 days	0%	100%
Total	317	
No response	2.5% (8)	

Limits of International Normalized Ratio (INR)

Table 3 illustrates practice patterns in reference to limits of INR. The majority of the respondents (above 90%) utilized INR limits of 1.5 or less for cervical epidural injections, lumbar interlaminar/transforaminal epidural, stellate ganglion block, lumbar sympathetic block, hypogastric plexus block and adhesiolysis. In reference to caudal epidurals, cervical/thoracic facet joints, lumbar facet joints, hip injections, sacroiliac joint injections, and shoulder injections were 84.2%, 79%, 73.4%, 66.8%, 66.4%, and 63.8% respectively.

Table 4 illustrates INR percentile limits. The 95th percentile INR was 1.6 for cervical and thoracic epidural; 2.0 for lumbar interlaminar, transforaminal, and caudal epidurals; 2.5 for cervical/thoracic facet joint injections; and 3.0 for lumbar facet joint injections. However, at the 90th percentile, it was 1.5 for all types of epidurals except caudal, which was 2. Cervical and thoracic facet joint injections were also 2 and lumbar facet joint injections were 2.5.

Discontinuing Antithrombotic Therapy

Table 5 illustrates discontinuing antithrombotic therapy, including antiplatelets. Surprisingly, approximately 39% of the 309 responding physicians stopped NSAIDs; the majority of them for 3 days and a small minority for 10 days. A similar number of physicians, approximately 39% or 125 of the 319 respondents, also discontinued aspirin (81 mg), with most of them stopping for 7 days.

Discontinuing aspirin 350 mg was even higher with 60% discontinuing it and most discontinuing it for 7 days (94 of 313).

In reference to antiplatelet therapy, 97% discontinued Pletal (Cilostazol), 97% discontinued ReoPro (abciximab), 96% discontinued Ticlid (ticlopidine), 95% discontinued Aggrastat (Tirofiban), 97% discontinued Plavix (clopidogrel),85% discontinued dipyridamole (Persantine, Permole), whereas, 96% discontinued all other types of antiplatelet therapy.

Adverse Effects With or Without Discontinuing Antithrombotic Therapy

Table 6 illustrates the frequency of adverse effects in patients undergoing interventional pain management techniques with either a continuation of antiplatelet therapy or discontinuation of antithrombotic therapy with warfarin and antiplatelets or with multiple agents. Overall, there were 162 thromboembolic events with 72 cerebral events, 59 coronary artery infarcts, 30 peripheral vascular infarcts, and a single report of pulmonary embolism. Of these, a total of 9 of 162 events were reported when antiplatelet therapy was continued, whereas 153 of 162 events were reported with discontinuation of warfarin as well as antiplatelet therapy.

In reference to bleeding complications, epidural hematoma was reported in a total of 55 patients; 26 when antiplatelet therapy was continued and 29 when antiplatelet therapy and warfarin were discontinued. Among these, 19 required only monitoring and anoth-

Table 3. *Practice patterns in reference to INR limits (less than/or equal) for interventional pain management techniques.*

Procedure	< 1.0	< 1.25	< 1.5	< 2.0	< 4.0	Total	No Response
Cervical/thoracic epidural	5.2% (16)	39.9% (123)	49.4% (152)	4.2% (13)	1.3% (4)	308	5.2% (17)
Cumulative Percent	5.2%	45.1%	94.5%	98.7%	100%		
Lumbar interlaminar/ Transforaminal epidural	3.0% (9)	33.8% (103)	54.4% (166)	6.9% (21)	2.0% (6)	305	6.% (20)
Cumulative Percent	3.0%	36.7%	91.1%	98.0%	100%		
Caudal epidural	1.7% (5)	29.6% (88)	52.9% (157)	11.8% (35)	4.0% (12)	297	8.5% (28)
Cumulative Percent	1.7%	31.3%	84.2%	96.0%	100%		
Cervical/thoracic facet joint injections	2.6% (7)	27.9% (76)	48.5% (132)	12.9% (35)	8.1% (22)	272	16.3% (53)
Cumulative Percent	2.6%	30.5%	79.0%	91.9%	100%		
Lumbar facet joint injections	1.9% (5)	21.6% (56)	49.8% (129)	13.9% (36)	12.7% (33)	259	20.3% (66)
Cumulative Percent	1.9%	23.6%	73.4%	87.3%	100%		
SI joint injections	1.7% (4)	21.3% (50)	43.4% (102)	16.6% (39)	17.0% (40)	235	27.7% (90)
Cumulative Percent	1.7%	23.0%	66.4%	83.0%	100.0%		
Hip	2.2% (5)	25.0% (58)	39.7% (92)	18.1% (42)	15.1% (35)	232	28.6% (93)
Cumulative Percent	2.2%	27.2%	66.8%	84.9%	100%		
Shoulder	1.8% (4)	22.1% (48)	39.9% (87)	18.3% (40)	17.9% (39)	218	32.9% (107)
Cumulative Percent	1.8%	23.9%	63.8%	82.1%	100%		
Stellate ganglion block	5.3% (15)	39.0% (110)	47.2% (133)	6.4% (18)	2.1% (6)	282	13.2% (43)
Cumulative Percent	5.3%	44.3%	91.5%	97.9%	100%		
Lumbar sympathetic block	4.2% (12)	39.6% (112)	48.1% (136)	6.0% (17)	2.1% (6)	283	12.9% (42)
Cumulative Percent	4.2%	43.8%	91.9%	97.9%	100%		
Hypogastric plexus block	4.7% (12)	40.9% (104)	45.7% (116)	6.7% (17)	2.0% (5)	254	21.8% (71)
Cumulative Percent	4.7%	45.7%	91.3%	98.0%	100%		
Adhesiolysis	8.1%(18)	36.9%(82)	47.7%(106)	5.9%(13)	1.4%(3)	222	31.7%(103)
Cumulative Percent	8.1%	45.0%	92.8%	98.6%	100%		
Other blocks	3.1%(5)	25.6%(41)	46.3%(74)	13.1%(21)	11.9%(19)	160	50.8%(165)
Cumulative Percent	3.1%	28.7%	75.0%	88.1%	100%		
Other injections	2.3%(3)	23.1%(30)	43.8%(57)	16.9%(22)	13.8%(18)	130	60%(195)
Cumulative Percent	2.3%	25.4%	69.2%	86.2%	100%		

Table 4. *Percentile limits of INR.*

		Percentile Values					
	Number	25th	50th	75th	80th	90th	95th
Cervical/thoracic epidural	308	1.2	1.3	1.5	1.5	1.5	1.6
Lumbar interlaminar/Transforaminal epidural	305	1.2	1.3	1.5	1.5	1.5	2
Caudal epidural	297	1.2	1.4	1.5	1.5	2	2
Cervical/thoracic facet joint injections	272	1.2	1.4	1.5	1.6	2	2.5
Lumbar facet joint injections	259	1.3	1.5	1.6	2	2.5	3
SI joint injections	235	1.3	1.5	2	2	2.9	3
HIP	232	1.2	1.5	2	2	2.5	3
Shoulder	218	1.3	1.5	2	2	3	3
Stellate ganglion block	282	1.2	1.3	1.5	1.5	1.5	2
Lumbar sympathetic block	283	1.2	1.3	1.5	1.5	1.5	2
Hypogastric plexus block	254	1.2	1.3	1.5	1.5	1.5	2
Adhesiolysis	222	1.2	1.3	1.5	1.5	1.5	1.9
Other blocks	160	1.2	1.5	1.6	1.8	2.5	3
Other injections	130	1.2	1.5	1.7	2	2.5	3

Table 5. *Practice patterns of discontinuation of antiplatelet agents.*

	None	3 days	5 days	7 days	10 days	15 days	>15 days	Total	No Response
NSAIDS	60.5% (187)	20.4% (63)	10.7% (33)	6.5% (20)	1.9% (6)	0%	0%	309	4.9% (16)
Cumulative %	60.5%	80.9%	91.6%	98.1%	100%	100%	100%		
Aspirin (81 mg)	60.8% (194)	7.2% (23)	9.4% (30)	18.8% (60)	3.4% (11)	0%	0.3% (1)	319	1.8% (6)
Cumulative %	60.8%	68.0%	77.4%	96.2%	99.7%	99.7%	100%		
Aspirin (350 mg)	39.6% (124)	8.9% (28)	16.0% (50)	30.0% (94)	4.8% (15)	0.3% (1)	0.3% (1)	313	3.7% (12)
Cumulative %	39.6%	48.6%	64.5%	94.6%	99.4%	99.7%	100%		
Plavix (Clopidogrel)	2.8% (9)	3.1% (10)	17.0% (54)	66.7% (212)	9.1% (29)	0.9% (3)	0.3% (1)	318	2.2% (7)
Cumulative %	2.8%	6.0%	23.0%	89.6%	98.7%	99.7%	100%		
Ticlid (Ticlopidine)	4.3% (13)	4.3% (13)	14.4% (44)	38.7% (118)	12.5% (38)	24.6% (75)	1.3% (4)	305	6.2% (20)
Cumulative %	4.3%	8.5%	23.0%	61.6%	74.1%	98.7%	100%		
Dipyridamole (Persantine, Permole)	14.6% (42)	9.1% (26)	17.4% (50)	43.2% (124)	10.1% (29)	4.9% (14)	0.7% (2)	287	11.7% (38)
Cumulative %	14.6%	23.7%	41.1%	84.3%	94.4%	99.3%	100%		
Pletal (Cilostazol)	7.3% (20)	7.3% (20)	20.1% (55)	51.1% (140)	10.2% (28)	3.3% (9)	0.7% (2)	274	15.7% (51)
Cumulative %	7.3%	14.6%	34.7%	85.8%	96.0%	99.3%	100%		
Tirofiban (Aggrastat)	4.6% (11)	13.0% (31)	14.6% (35)	47.3% (113)	13.0% (31)	5.4% (13)	2.1% (5)	239	26.5% (86)
Cumulative %	4.6%	17.6%	32.2%	79.5%	92.5%	97.9%	100%		
Abciximab (Reopro)	3.0% (7)	17.3% (40)	16.5% (38)	45.0% (104)	11.3% (26)	4.8% (11)	2.2% (5)	231	28.9% (94)
Cumulative %	3.0%	20.3%	36.8%	81.8%	93.1%	97.8%	100%		
Others (Xarelto, Pradaxa, Dabigatran)	3.5% (7)	25.7% (52)	27.7% (56)	31.7% (64)	8.4% (17)	3.0% (6)	0%	201	37.8% (124)
Cumulative %	3.5%	29.2%	56.9%	88.6%	97.0%	100%	100%		

Table 6. *Illustration of frequency of adverse effects during interventional pain management techniques.*

Complications	Antithrombotic Therapy		
	Continued antiplatelet therapy	Discontinued antiplatelet and warfarin therapy	Total
Thromboembolic Events			
Coronary artery infarct or event	5	54	59
Cerebral infarct or event	2	70	72
Peripheral vascular infarct	2	28	30
Pulmonary embolism	0	1	1
Total	9	153	162
Bleeding Complications			
Epidural Hematoma			
Requiring only monitoring	12	7	19
Without surgical intervention ***With*** significant neurological dysfunction	2	2	4
With surgical intervention *Without* neurological dysfunction	10	9	19
With surgical intervention ***With*** significant neurological dysfunction	2	11	13
Total	26	29	55

er 19 resolved without neurological dysfunction with surgical intervention. However, 4 of them developed significant neurological dysfunction without surgical intervention and 13 of them developed significant neurological dysfunction with surgical intervention. The residual neurologic dysfunction was the same (2 versus 2) without surgical intervention, while it was different after surgical interventions with 2 cases in the antiplatelet therapy continued group compared to 11 cases in the discontinued group of all antithrombotics.

Discussion

This survey of contemporary interventional pain management practices in the United States illustrates 217 serious adverse events related to either thromboembolic phenomena or epidural hematomas, with thromboembolic events 3 times more frequent than serious bleeding events. A total of 162 thromboembolic events were reported involving coronary artery events (59), cerebral events (72), peripheral vascular events (30), or pulmonary embolism (1).

In contrast, there were 55 events related to epidural hematomas. Among these, 32 of them required surgical intervention, whereas 19 required only monitoring. Four of them had no surgical intervention, but developed neurological dysfunction, whereas 19 of them underwent surgical intervention without any residual dysfunction; 13 suffered significant neurological dysfunction even after surgery. The complications of epidural hematomas were noted in 29 of 55 patients despite discontinuing warfarin and antiplatelet therapy. In contrast, when warfarin and antiplatelet therapy were discontinued, thromboembolic events were higher, with 153 of 162 events.

However, the incidences of complications in each category may not be accurate because of the variations in the proportion of patients who continued or discontinued antiplatelet therapy.

Thus, the occurence of epidural hematoma was similar in both groups whether antithrombotic therapy was discontinued or not; however, of the 19 epidural hematomas described requiring only monitoring, the majority of them (12 of 19) were in the group who continued antiplatelet therapy. The epidural hematoma formation requiring surgical intervention resulting in significant neurological dysfunction was 5 times higher in those who discontinued antiplatelet therapy, with 11 of 13 cases. In contrast, in the category with surgical intervention without resultant neurological dysfunction, 10 of 19 continued antiplatelet therapy, whereas 9 of 19 discontinued warfarin and antiplatelet therapy. Overall, significant residual neurological dysfunction was in 4 of 55 patients in the group that continued antiplatelet therapy versus 13 of 55 patients who discontinued warfarin and antiplatelet therapy.

This study was conducted among contemporary interventional pain management practitioners with a 14% response rate. The results of this study are rather surprising—thromboembolic events were 3 times higher than serious bleeding complications.

The reported occurence of epidural hematoma was a total of 55 cases, similar to reports from regional anesthesia. Due to a large number of physicians with practices for several years, sample size may be adequate to assess appropriate incidence of epidural hematoma. However, this is the first study of thromboembolic events and epidural hematoma formation caused by interventional pain management techniques. Epidural hematoma incidences have been studied through case reports and small studies in regional anesthesia, but thromboembolic events have not been assessed in relation to regional anesthesia, except in a global setting of perioperative management.

In a study of over 2,200 patients with drug-eluting stents and a thrombosis rate of 1.5% during the first year, premature clopidogrel discontinuation was the most significant independent predictor of stent thrombosis, with a hazard ratio of 57.13 and a mortality rate linked to stent thrombosis of 45% (46). In addition, patients who discontinued clopidogrel during the first month after percutaneous coronary intervention are 10 times more likely to die or to be re-hospitalized during their next 11 months compared to patients who took the drug continually. In a systematic review and meta-analysis on the hazards of discontinuing or not adhering to aspirin (35), the results showed that overall aspirin nonadherence/withdrawal was associated with a 3-fold higher risk of major adverse cardiac events. The risk was magnified in patients with intracoronary stents, as discontinuing antiplatelet treatment was associated with an even higher risk of adverse events. The authors concluded that noncompliance or withdrawal of aspirin treatment has ominous prognostic implications in patients at moderate to high risk for coronary artery disease. They suggested that discontinuing aspirin in such patients should be done only when the bleeding risk clearly overwhelms that of atherothrombotic events. Thus, discontinuing antiplatelet therapy or nonadherence have been reported with ominous prognostic implications (4,31,45,46).

Epidural hematoma classically presents with radicular pain, motor impairment, sensory loss, and urinary retention. In patients with subarachnoid injections or epidural infusions, some of the features may be obtunded, making a diagnosis difficult. The literature suggests that motor block is the most sensitive prognostic indicator (70,71). An epidural hematoma related to an epidural catheter may occur at any time after insertion, including after removal (72).

The occurrence of epidural hematoma in relation to procedures performed for pain relief is not known; however, based on the experience from regional anesthesia, it may occur up to 12 hours after the procedure has been performed. The investigation of choice for a suspected epidural hematoma is a magnetic resonance imaging scan (73,74). Early detection of epidural hematoma and prompt treatment can make a profound difference in outcomes. The definitive treatment for an epidural hematoma is surgical decompression by laminectomy. The factors that determine the outcome or the severity of the neurological deficit are initially presentation of deficit and the time from the presentation to surgery (70,71). If surgery is carried out within 12 hours of symptom onset, recovery rates are better than 60%, but if surgery takes place more than 24 hours after the presentation of symptoms, recovery rates drop to about 10% (72). This demonstrates the importance of regular assessment of a patient's motor function.

In the present evaluation, 55 hematomas were found and 32 were diagnosed promptly and treated with surgical intervention; 23 were treated conservatively. Significant residual dysfunction was present in 13 of 32 (41%) surgical decompressions and 4 of 23 (17%) conservative management cases. Conservative management of an epidural hematoma involves a watchful eye with appropriate monitoring and potential administration of Vitamin K (75-77).

Some may argue that since interventional pain management techniques have not proven to be effective, they should not be performed at all, specifically in patients on antithrombotic therapy. However, due to multiple comorbid factors, these are the patients who may require interventional pain management therapy even more than healthy individuals. Interventional pain management techniques have been proven to be effective in multiple randomized, controlled trials and systematic reviews, even though their effectiveness continues to be debated (6,11-15,78-92). Further, interventional pain management techniques may also be associated with other problems related to infections and aspiration in patients with multiple comorbid factors (93,94). However, the inability to provide interventional pain management techniques safely may lead to excessive opioid use, abuse, and many adverse consequences (95-99).

Based on the results of this evaluation, the majority of interventional pain management physicians (95%) appear to stop antiplatelet therapy prior to performing interventional pain management techniques. As described earlier, there may be substantial risk associated with this type of practice pattern. As of now, based on publications and the current assessment, the evidence appears that there is not an inordinate risk of bleeding, specifically epidural hematoma formation, when antiplatelet therapy is continued during interventional pain management techniques. The risk appears to be the same and may be similar to spontaneous hematoma formation.

Limitations of this survey include that the survey was conducted via e-mail and the low response rate was due to its being conducted among a select group of interventional pain management physicians. Generally, it is a common assumption that the results show significant underreporting, specifically related to complications. This assessment also has not evaluated underlying spinal pathology resulting in epidural hematomas as a causative factor. However, in medicine, it is common to obtain various types of data by surveys. With the widespread availability of the Web and e-mail, Web surveys have been the subject of much hyperbole about their capabilities, as well as some criticism about their limitations (100). Based on the Internet and Web survey, we had a response rate of 14%. Response rates for Web-only surveys using probability samples or census data showed rates varied from 8% to 44% (100). It has been stated that response by mail appears to be superior to the Web. A 14% response rate is considered appropriate for this study. Web surveys do offer timeliness, which is extremely important in medical practices. The quality of the responses appears to be similar whether it is based on mail or the Web. Thus, some may consider the Web-based survey as a disadvantage; however, considering the available literature, the results appear to be similar to the available published literature, as well as mail surveys. Another disadvantage is underestimation based on recollection of adverse events.

In summary, the risk of bleeding and epidural hematoma formation with interventional pain management techniques is rare. However, the risk of cerebrovascular, cardiovascular, or peripheral vascular incidents

is 3 times higher with an occurrence of 162 cases. Further, this survey shows that despite numerous articles about the risks of discontinuing antiplatelet therapy, and the lack of evidence concerning the benefits of discontinuation, the majority appear to discontinue antiplatelet therapy anyway.

Conclusion

The results illustrate an overwhelming pattern of discontinuing antiplatelet and warfarin therapy prior to performing interventional pain management techniques, except for aspirin and other NSAIDs. However, complications of thromboembolism are 3 times more prevalent than epidural hematomas (162 versus 55 events). It is concluded that clinicians must balance the risks of thromboembolism and bleeding in each patient prior to routine discontinuation of antiplatelet therapy.

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Author Affiliations

Dr. Manchikanti is Medical Director of the Pain Management Center of Paducah, Paducah, KY, and Clinical Professor, Anesthesiology and Perioperative Medicine, University of Louisville, Louisville, KY.

Dr. Benyamin is the Medical Director, Millennium Pain Center, Bloomington, IL, and Clinical Assistant Professor of Surgery, College of Medicine, University of Illinois, Urbana-Champaign, IL.

Dr. Swicegood is Medical Director, Advanced Interventional Pain and Diagnostics of Western Arkansas, Fort Smith, AR.

Dr. Falco is Medical Director of Mid Atlantic Spine & Pain Physicians, DE; Director, Pain Medicine Fellowship Program, Temple University Hospital, Philadelphia, PA, and Associate Professor, Department of PM&R, Temple University Medical School, Philadelphia, PA.

Dr. Datta is Medical Director, Laser Spine & Pain Institute, New York, NY, and Professorial Lecturer, Mount Sinai School of Medicine, Department of Anesthesiology, New York, NY.

Vidyasagar Pampati is a Statistician at the Pain Management Center of Paducah, Paducah, KY.

Bert Fellows is Director Emeritus of Psychological Services at the Pain Management Center of Paducah, Paducah, KY.

Dr. Hirsch is Chief of Minimally Invasive Spine Surgery, Depts. of Radiology and Neurosurgery, Massachusetts General Hospital and Associate Professor of Radiology, Harvard Medical School, Boston, MA.

Conflict of Interest:

Dr. Benyamin is a consultant with Bioness and Nevro, serves on the advisory boards of Vertos Medical and Nuvo Pharma, teaches/lectures for Vertos Medical, Boston Scientific, Neurotherm, and Bioness, and receives research/grants from Alfred Mann Foundation, Teknon Foundation, Spinal Restoration, Inc., Bioness, Boston Scientific, Vertos Medical, Medtronic, Kimberly Clarke, Epimed, BioDelivery Sciences International, Inc., Theravance, Mundipharma Research, Cephalon/Teva, AstraZeneca, and Purdue Pharma, LP.

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