Health Policy Review

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

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Background: The role of antiplatelet/anticoagulant therapy is well known for its primary and secondary prevention of sequela from cardiovascular disease by decreasing the incidence of acute cerebral, cardiovascular, peripheral vascular, and other thrombo-embolicevents. 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.

A survey of practice patterns was conducted in 2012, since then the risks associated with thromboembolic events and bleeding, has not been systematically evaluated.

Objective: To conduct an updated assessment of the perioperative antiplatelet and anticoagulant practice patterns of U.S. interventional pain management physicians and compare this with data collected in 2012 with 2021 data regarding practice patterns of continuing or discontinuing anticoagulant therapy.

Study Design: Postal survey of interventional pain management physicians.

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

Methods: The survey was conducted based on online responses of the members of the American Society of Interventional Pain Physicians (ASIPP) in 2021. The survey was designed similar to the 2012 survey to assess updated practice patterns.

Results: The questionnaire was sent out to 1,700 members in October 2021. Out of these, 185 members completed the survey, while 105 were returned due to invalid addresses.

The results showed that 23% changed their practice patterns during the previous year. The results also showed that all physicians discontinued warfarin therapy with the majority of physicians accepting an INR of 1.5 as a safe level. Low dose aspirin (81 mg) was discontinued for 3 to 7 days for low-risk procedures by 8% of the physicians, 34% of the physicians for moderate or intermediate risk procedures, whereas they were discontinued by 76% of the physicians for high-risk procedures. High dose aspirin (325 mg) was discontinued at a higher rate. Antiplatelet agents, including dipyridamole, cilostazol, and Aggrenox (aspirin, extended-release dipyridamole) were discontinued from 3 to 5 days by 18%-23% of the physicians for low-risk procedures, approximately 60% of the physicians for moderate or intermediate-risk procedures, and over 90% of the physicians for high-risk procedures. Platelet aggregation inhibitors clopidogrel, prasugrel, ticlopidine, and ticagrelor were discontinued for 3 to 5 days by approximately 26% to 41% for low-risk procedures, almost 90% for moderate or intermediate-risk procedures, and over 97% for high-risk procedures. Thrombin inhibitor dabigatran was discontinued by 33% of the physicians for low-risk procedures, 92% for moderate or intermediate-risk procedures, and 99% for high-risk procedures. Anti-Xa agents, apixaban, rivaroxaban, and Edoxaban were discontinued in over 25% of the physicians for low-risk procedures, approximately 90% for moderate or intermediate-risk procedures, and 99% for high-risk procedures.

Limitations: This study was limited by its being an online survey of the membership of one organization in one country, that there was only a 11.6% response rate, and the sample size is relatively small. Underreporting in surveys is common. Further, the incidence of thromboembolic events or epidural hematomas was not assessed.

Conclusion: The results in the 2021 survey illustrate a continued pattern of discontinuing antiplatelet and anticoagulant therapy in the perioperative period. The majority of discontinuation patterns appear to fall within guidelines.

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

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Introduction

The management of patients on anticoagulant and antiplatelet therapy with interventional techniques is a challenge for interventional pain physicians and their patients. Interventional pain management techniques are performed to improve functional impairment in chronic, persistent pain, which have been used with increasing frequency (1-10). It has been estimated that approximately 25% of the patients presenting for interventional pain management techniques are on either antiplatelet or anticoagulant therapy (11-16). Anticoagulant and antiplatelet therapy is common in the presence of atrial fibrillation, deep venous thrombosis (DVT), pulmonary embolism, placement of prosthetic valves, coronary, cerebral and peripheral vascular events (17-21). Consequently, the importance of anticoagulant and antiplatelet therapy has been demonstrated overwhelmingly. Thus, the risks of interruption of anticoagulant and antiplatelet therapy leading to cerebrovascular and cardiovascular complications may be even higher based on significant morbidity and mortality, whereas the risks of epidural hematoma may be corrected to some extent with appropriate management, leading to lesser morbidity and mortality (1,11,13-16).

The interruption or discontinuation of therapy can increase the risk of thrombotic events during and after interventional procedures. However, the continuation or non-interruption of the therapy can heighten the risk of bleeding during surgery and trigger a sequence of undesirable outcomes ranging from minor to uncontrolled bleeding with reported epidural hematomas and neurological sequelae.

Multiple guidelines have been developed in various medical specialties, as well as in anesthesiology and interventional pain management (14-17,22,23). The majority of these guidelines are derived from case reports.

Based on a survey performed in 2012 of interventional pain physicians, discontinuation of antiplatelet therapy and anticoagulant therapy is common (13). The survey results showed discontinuation rate of warfarin therapy (99%), clopidogrel (97%), ticlopidine (96%), Aggrastat (tirofiban) (95%), cilostazol (93%), dipyridamole (85%), aspirin 350 mg (60%), aspirin 81 mg (39%), and other nonsteroidal anti-inflammatory agents (NSAIDs) (39%). In addition, the majority of the physicians accepted an international normalized ratio (INR) of 1.5 or less as a safe level. Similarly, in another survey performed in the same year by the American Society of Regional Anesthesia and Pain Medicine (ASRA) (16), 55% stopped aspirin before spinal cord stimulation (SCS) trials and implants and 32% stopped before epidural steroid injections. Interestingly, in these studies, physicians have utilized different protocols for cervical spine injections as compared with lumbar spine injections.

Since the publication of both surveys (13,16), systematic assessments have not been performed. Consequently, this assessment was undertaken to update the practice patterns of perioperative management of antiplatelet and anticoagulant therapy in interventional pain management.

Methods

A physician survey of antithrombotics use in inter-

ventional 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. Table 1 shows the questionnaire. Responders were able to submit the data either electronically or manually.

A list of 1,700 interventional pain management physicians were obtained from the American Society of Interventional Pain Physicians (ASIPP). The survey was e-mailed to physicians. The survey was carried out from October 2021 through January 2022.

Results

The survey was mailed out to 1,700 members in October 2021. Out of these, 185 members completed the survey, while 105 were returned due to invalid addresses.

Practice Settings

The results of practice settings showed 2 or more settings in the majority of the practitioners with approximately 63% of the respondents (117), which included either office, ambulatory surgery center (ASC), or hospital outpatient department (HOPD), followed by solely in-office practitioners constituting 25.9%, with HOPD only involving 20 practitioners, or 10.8%.

Shifts in antithrombotic practice patterns over the past year.

The survey results indicated that 77% of the practitioners had not changed their practices, while 23% had made changes.

Discontinuation of Warfarin

Table 2 details the patterns of discontinuing warfarin before performing interventional pain management techniques. Patterns of discontinuation differed from the 2012 survey responses to the present survey as shown in Table 2 (13). The results of the current survey showed warfarin was discontinued 5 days prior in 80.7% of the patients whereas it was 15.1% in the previous survey. Further, a significant proportion of 64% stopped for 7 days in the 2012 survey. This indicates that physicians continue to follow the routine of stopping warfarin for 5 days.

Limits of International Normalized Ratio (INR)

Table 3 presents the practice patterns regarding INR limits. The majority of respondents (over 94%) adhered to an INR limit of 1.5 or less for all high-risk procedures, which include all interlaminar epidural injections, cervical, thoracic, and lumbar (above L5), spinal cord stimulator trials and implants, percutaneous adhesiolysis via interlaminar or transforaminal approach, percutaneous disc decompression, sympathetic blocks (stellate ganglion, thoracic splanchnic, celiac plexus), thoracic and cervical intradiscal procedures, vertebral augmentation, lumbar (above L4), thoracic and cervical intrathecal catheter and pump implants, interspinous prosthesis, and minimally invasive lumbar decompression (MILD). Survey of the INR results were similar in 2021 compared to 2012 with a requirement of INR of 1.5 or below over 90% of the times in both surveys; however, physicians appear to be more cautious in 2021 with a slightly higher proportion achieving INR of 1.5 or less for all interlaminar epidural injections (94% vs. 91.1%). However, for low-risk procedures, a higher INR was acceptable in 2012 survey compared to 2021 for sacroiliac joint interventions, facet joint interventions, and ganglion impar blocks with reversal for caudal epidural injections, facet joint interventions, and ganglion impar blocks with a large proportion requiring INR of 1.5 or less.

For moderate or intermediate-risk procedures, including transforaminal epidural injections, 82% considered an INR of 1.5 or less to be optimal. This limit was also deemed optimal by 95% for transforaminal epidurals above L3 and 82% below L3, 87% for lumbar intradiscal procedures, 92% for hypogastric plexus and lumbar sympathetic blocks, 83% for peripheral nerve stimulation trials and implants, 84% for pocket revisions and implantable pulse generator intrathecal pump replacements, 89% for caudal percutaneous adhesiolysis, and 90% for lumbar vertebral augmentation. Additionally, 86% considered 1.5 or less as optimal for lumbar percutaneous disc decompression at L4/5 or below.

For facet joint interventions, including intraarticular injections, nerve blocks, and radiofrequency thermoneurolysis, 11% did not check INR, 46% considered 1.5 as optimal, and a significant portion (31%) deemed an INR of 2 or above acceptable.

For low-risk procedures, the majority preferred an INR of 2 or above: 38% for trigger point injections, 45% for peripheral joint injections, 43% for peripheral nerve blocks, and 36% for sacroiliac joint and ligament injec-

Table 1. *List of items in questionnaire.*

Questionnaire

AMERICAN SOCIETY OF INTERVENTIONAL PAIN PHYSICIANS
THE VOICE OF INTERVENTIONAL PAIN MANAGEMENT

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

Please type or print your information clearly. When completed, mail to: ASIPP, 81 Lakeview Drive, Paducah, KY 42001 *or Fax:* 270.554.5394

Name: _____ City: _____ State: _____

Number of Years in the Practice: _____ Specialty: _____

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

Working status: ☐ Employed by a hospital or hospital-owned medical group
☐ Employed by a physician-owned medical group ☐ Practice owner or partner
☐ _____

Completing the survey as: ☐ Individual ☐ Group If group, how many MD\DO: _____

1. i. Total number procedures performed per year by region:
   Cervical: ____ Thoracic: ____ Lumbar ____
   ii. Number of years in the practice: ____
2. i. Have you practice pattern changed in the past year on antithrombotics? ☐ No ☐ Yes
   ii. What is your philosophy and practice pattern on discontinuing antithrombotic or related agents?
   _____

	Low Risk				Intermediate-Risk Procedures				High Risk			
	None	3 days	5 days	>=7 days	None	3 days	5 days	>=7 days	None	3 days	5 days	>=7 days
NSAIDS: (COX 1) or (COX 2)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
THC/CBD	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Aspirin												
Low-Dose Aspirin	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
High Dose Aspirin	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Antiplatelet Agents												
Dipyridamole (Persantine)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Cilostazol (Pletal)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Aggrenox	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Platelet Aggregation Inhibitors												
Clopidogrel (Plavix)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Prasugrel (Effient)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ticlopidine (Ticlid)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Ticagrelor (Brilinta)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Thrombin Inhibitors												
Dabigatran (Pradaxa)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Table 1 cont. *List of items in questionnaire.*

* continued	Low Risk				Intermediate-Risk Procedures				High Risk			
	None	3 days	5 days	>=7 days	None	3 days	5 days	>=7 days	None	3 days	5 days	>=7 days
Anti-Xa Agents												
Apixaban (Eliquis)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Rivaroxaban (Xarelto)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Edoxaban (Savaysa, Lixiana)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
GPIIb/IIIa Inhibitors												
Abciximab (ReoPro)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Eptifibatide (Integrilin)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Tirofiban (Aggrastat)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Miscellaneous												
Fondaparinux (Arixtra)	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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

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

   iii. Has it changed in the past year? ☐ No ☐ Yes If yes, _____

4. What are your limits for INR on the following procedures (mark 'X' if you do not perform)?

Low-Risk Procedures	INR Limit	Intermediate-Risk Procedures*	INR Limit	High-Risk Procedures*	INR Limit
Trigger point and muscular injections (including piriformis injection)		Facet joint interventions (intra-articular injections, nerve blocks and radiofrequency neurotomy)		Cervical, thoracic, and lumbar interlaminar epidurals	
Peripheral joints		Lumbar transforaminal epidural injections at L4, L5, S1		Cervical, thoracic and lumbar above L3 transforaminal epidural injections	
Peripheral nerve blocks		Lumbar intradiscal procedures		Spinal cord stimulator trial and implant	
Sacroiliac joint and ligament injections and nerve blocks		Hypogastric plexus blocks		Percutaneous adhesiolysis with interlaminar or transforaminal approach	
Caudal epidural injections		Lumbar sympathetic blocks		Percutaneous disc decompression (above L4/5)	
Ganglion impar blocks		Peripheral nerve stimulation trial and implant		Sympathetic blocks (stellate ganglion; thoracic splanchnic, celiac plexus)	
		Pocket revision and implantable pulse regenerator/intrathecal pump replacement		Thoracic and cervical intradiscal procedures	
		Caudal percutaneous adhesiolysis		Vertebral augmentation, lumbar (above L4), thoracic and cervical	
		Lumbar percutaneous disc decompression (L4/5 or below)		Intrathecal catheter and pump implant	
		Lumbar vertebral augmentation (below L4)		Interspinous prosthesis and MILD®	

**Patients with high risk of bleeding (e.g., old age, history of bleeding tendency, concurrent uses of other anticoagulants/antiplatelets, liver cirrhosis or advanced liver disease, and advanced renal disease) undergoing low or intermediate-risk procedures should be treated as intermediate or high risk, respectively*

tions and nerve blocks. However, for caudal epidural injections, 68% considered 1.5 as optimal, and 44% considered 1.5 as optimal for ganglion impar blocks.

Table 2. *Comparative evaluation of patterns of discontinuing warfarin prior to interventional pain management techniques.*

	Current Survey 2021 (176)		2012 Survey (317)	
	Percent (n)	Cumulative %	Percent (n)	Cumulative %
3 days	6.8% (12)	6.8%	2.2% (7)	2.2%
5 days	80.7%* (142)	87.5%	15.1% (48)	17.4%
7 days	11.4% (20)	98.9%	64.0*% (203)	81.4%
>=10 days	1.1% (2)	100.0%	1.9% (6)	100%

Management of Antiplatelet and Anticoagulant Therapy in Perioperative Period

Overall, as outlined in Table 4, management patterns of antiplatelet and anticoagulant agents were variable from the guidelines. The majority of them stopped longer than the required periods, specifically for direct oral anticoagulants.

Low-dose aspirin was discontinued for 3 to 7 days by 8% of physicians for low-risk procedures, 34% for moderate or intermediate-risk procedures, and 76% for high-risk procedures. High-dose aspirin was discontinued at higher rates.

Antiplatelet agents, including dipyridamole, cilostazol, and Aggrenox (aspirin, extended-release dipyridamole), were discontinued for 3 to 5 days by 18%-23%

Table 3. *Comparative analysis of patterns of acceptable INR prior to performing interventional pain management techniques.*

	Current Survey (2021)				Previous Survey (2012)			
	≤ 1.50	1.51-2.0	> 2.0	Total	≤ 1.50	1.51-2.0	> 2.0	Total
Procedures categorized as high-risk include:								
Cervical, thoracic, and lumbar (above L5) interlaminar epidurals	94% (150)	4% (7)	1% (2)	159	91.1% (278)	6.9% (21)	2.0% (6)	305
Sympathetic blocks (stellate ganglion, thoracic sympathetic, splanchnic, celiac plexus)	95% (142)	4% (6)	1% (1)	149				
Lumbar sympathetic blocks	92% (130)	7% (10)	1% (2)	142	91.9% (260)	6.0% (17)	2.1% (6)	283
Hypogastric plexus blocks	92% (122)	7% (9)	2% (2)	133	91.3% (232)	6.7% (17)	2.0% (5)	254
Procedures categorized as moderate or intermediate-risk include:								
Caudal epidural adhesiolysis	89% (74)	8% (7)	2% (2)	83	92.8% (206)	5.9% (13)	1.4% (3)	222
Caudal epidural injections	68% (98	13% (19)	10% (15)	144	84.2% (250)	11.8% (35)	4.0% (12)	297
Cervical, thoracic, and lumbar transforaminal at L1 and L2	95% (143)	4% (6)	1% (1)	150				
Procedures categorized as low-risk include:								
Trigger point and intramuscular injections (including piriformis injection)	17% (23)	16% (22)	38% (52)	137				
Peripheral nerve blocks including mandibular and maxillary nerve blocks	20% (27)	14% (19)	43% (58)	134				
Sacroiliac joint and ligament injections and nerve blocks	28% (38)	12% (16)	36% (50)	138	66.4% (156)	16.6% (39)	17.0% (40)	235
Facet joint interventions (intra-articular injections, medial branch and L5 dorsal ramus nerve blocks and radiofrequency neurotomy)	46% (65)	11% (16)	31% (44)	140	73.4% (190)	13.9% (36)	12.7% (33)	259
Intraarticular injections of extremity joints								
Lumbar transforaminal epidural injections at L3, L4, L5, and S1	82% (121)	14% (21)	3% (5)	147				
Ganglion impar blocks	44% (47)	23% (24)	15% (16)	106	91.5% (258)	6.4% (18)	2.1% (6)	282

Table 4. *Management patterns of antiplatelet agents.*

	Low Risk Procedures					Moderate or Intermediate-Risk Procedures					High Risk Procedures				
	No Response	None	3 days	5 days	≥ 7 days	No Response	None	3 days	5 days	≥ 7 days	No Response	None	3 days	5 days	≥ 7 days
NSAIDS: (COX 1) or (COX 2)	27	87% (138)	7% (11)	5% (8)	1% (1)	45	61% (85)	22% (31)	10% (14)	7% (10)	22	36% (59)	12% (20)	36% (59)	15% (25)
THC/CBD	30	98% (151)	1% (2)	1% (2)	-	47	90% (124)	4% (5)	3% (4)	4% (5)	23	80% (129)	2% (4)	5% (8)	13% (21)
Aspirin															
Low-Dose Aspirin	2	92% (169)	2% (3)	5% (9)	1% (2)	20	66% (109)	13% (21)	8% (14)	13% (21	20	24% (40)	6% (6)	38% (63)	32% (53)
High Dose Aspirin	8	86% (152)	5% (8)	3% (6)	6$ (11)	22	50% (82)	9% (14)	17% (28)	24% (39)	22	10% (16	7% (12)	37% (61)	46% (74)
Antiplatelet Agents (Phosphodiesterase Inhibitors)															
Dipyridamole (Persantine)	50	82% (111)	7% (9)	5% (7)	6% (8)	66	40% (48)	25% (30)	16% (19)	19% (22)	38	7% (10)	48% (70)	16% (23)	30% (44)
Cilostazol (Pletal)	50	82% (110)	7% (10)	5% (7)	6% (8)	69	41% (47)	22% (26)	17% (20)	20% (23)	35	5% (7)	51% (77)	15% (23)	29% (43)
Aggrenox	49	77% (105)	9% (12)	6% (8)	8% (11)	64	37% (45)	17% (21)	17% (21)	28% (34)	38	5% (8)	13% (19)	44% (65)	38% (55)
Platelet Aggregation Inhibitors															
Clopidogrel (Plavix)	10	59% (104)	3% (5)	22% (38)	16% (28)	27	10% (15)	2% (4)	33% (52)	55% (87)	35	1% (1)	1% (2)	17% (26)	81% (121)
Prasugrel (Effient)	48	69% (94)	6% (8)	9% (12)	17% (23)	33	11% (17)	6% (9)	19% (29)	64% (97)	39	1% (1)	10% (15)	16% (23)	73% (107)
Ticlopidine (Ticlid)	22	74% (121)	4% (6)	12% (19)	10% (17)	63	12% (15)	7% (8)	35% (43)	46% (56)	69	3% (3)	7% (8)	34% (39)	57% (66)
Ticagrelor (Brilinta)	47	71% (98)	5% (7)	13% (18)	11% (15)	38	10% (15)	8% (12)	57% (84)	25% (36)	31	1% (1)	8% (13)	54% (83)	37% (57)
Direct Oral Anticoagulants															
Dabigatran (Pradaxa)	44	67% (94)	11% (16)	14% (19)	8% (12)	37	8% (12)	17% (25)	60% (89)	15% (22)	42	1% (1)	22% (31)	55% (79)	22% (32)
Apixaban (Eliquis)	3	72% (130)	23% (42)	3% (6)	2% (4)	26	9% (15)	72% (115)	15% (23)	4% (6)	26	1% (1)	79% (125)	12% (19)	9% (14)
Rivaroxaban (Xarelto)	3	72% (131)	23% (42)	3% (6)	2% (3)	26	9% (15)	73% (116)	13% (21)	4% (7)	26	1% (1)	77% (122)	13% (21)	9% (15)
Edoxaban (Savaysa, Lixiana)	7	77% (137)	18% (32)	3% (6)	2% (3)	42	11% (15)	69% (99)	16% (23)	4% (6)	44	1% (2)	75% (106)	14% (19)	10% (14)

of physicians for low-risk procedures, approximately 60% for moderate or intermediate-risk procedures, and over 90% for high-risk procedures.

Platelet aggregation inhibitors such as clopidogrel, prasugrel, ticlopidine, and ticagrelor were discontinued for 3 to 5 days by 26%-41% of physicians for low-risk procedures, nearly 90% for moderate or intermediate-risk procedures, and over 97% for high-risk procedures.

The thrombin inhibitor dabigatran was discontinued by 33% of physicians for low-risk procedures, 92% for moderate or intermediate-risk procedures, and 99% for high-risk procedures.

Anti-Xa agents, including apixaban, rivaroxaban, and edoxaban, were discontinued by over 25% of physicians for low-risk procedures, approximately 90% for moderate or intermediate-risk procedures, and 99% for high-risk procedures.

Discussion

The present analysis shows a 23% change in physician practice patterns during the previous year. The same findings were observed in individual practice patterns of antiplatelets and anticoagulant drugs. Overall, the results showed that all physicians discontinued warfarin therapy with the majority of physicians accepting an INR of 1.5 as a safe level. However, a higher majority of positions discontinued warfarin therapy for 5 days instead of some discontinuing for 3 days. Low dose aspirin (81 mg) was discontinued for 3-7 days by 76% of physicians for high-risk procedures, 34% of physicians for moderate or intermediate-risk procedures, and only 8% of the physicians for low-risk procedures. In contrast, high-dose aspirin was discontinued at a higher rate.

Platelet aggregation inhibitors clopidogrel, prasugrel, ticlopidine, and ticagrelor were discontinued for 3-5 days for over 97% for high-risk procedures, 90% for immediate-risk procedures, and 26%-41% for low-risk procedures.

Among anticoagulants, thrombin inhibitor dabigatran was discontinued by 99% for high-risk procedures, 92% for moderate or intermediate-risk procedures, and 33% for low-risk procedures and factor Xa agents apixaban, rivaroxaban and endoxaban were discontinued in over 99% for high-risk procedures, 90% for moderate or intermediate-risk procedures, and 25% for low-risk procedures.

Overall, the cessation of anticoagulant and antiplatelet agents shows longer than the recommended guidance available in 2021. Since then, multiple changes have been made in guidelines with changing classifications by ASRA guidance, as well as ASIPP guidance (1,14-16). The 2024 guidelines from ASIPP are based on risk stratification of interventional techniques utilizing anatomical risk factors, procedural risk factors, bleeding risk, antiplatelet and anticoagulation risk and medical or physiological risk as shown in Table 5 (15). Risk was stratified into low-risk, moderate or intermediate-risk, and high-risk with composite scores of 8 or less for low-risk, 9-12 for moderate or intermediate risk, and 13 or above for high-risk categories. In addition, ASIPP guidelines have recommended perioperative withholding times of antiplatelet or anticoagulant drugs for interventional procedures similar to the recommendations by cardiology societies.

Figure 1 shows the recommended perioperative withholding times of antiplatelet and anticoagulant drugs for interventional procedures.

These recommendations show that for high-risk procedures, aspirin, clopidogrel (Plavix), and prasugrel (Effient) are discontinued 6 days prior to the procedures and resumed after one day. In reference to ticagrelor (Brilinta), it is discontinued for 5 days and resumed after one day. For ticlopidine (Ticlid), which has been discontinued in the United States, for high-risk procedures, it is stopped for 7 days and resumed after one day. For intermediate or moderate-risk procedures, aspirin is stopped for 3 days, clopidogrel (Plavix) for 5 days, prasugrel (Effient) for 5 days, ticagrelor (Brilinta) for 3 days, and ticlopidine (Ticlid) for 7 days with resuming intake after one day. For low-risk procedures, recommendations are highly variable based on our evidence and previous recommendations and the literature. For low-risk procedures, all the drugs may be continued or stopped as in intermediate or moderate risk procedures.

Figure 2 shows perioperative management of patients receiving direct oral anticoagulants (DOACs) during interventional procedures.

The concept of continuation or discontinuation of anticoagulants and antiplatelets has been undergoing significant changes specifically based on the best practices developed for medical guidance (17-23). Further, guidelines have been revised extensively by ASIPP and ASRA with the risk stratification and guidance on antiplatelet and anticoagulant therapy. Literature has also been published showing not only the deleterious effects of epidural hematoma with continuation, which often can be managed compared to the devastating effects of cerebrovascular and cardiovascular events,

Table 5. *Risk stratification of interventional techniques based on anatomical risk factors, procedural risk factors, bleeding risk, antiplatelet/anticoagulant risk, and medical or physiological status.*

	Anatomical Risk Factors	Procedural Risk Factors	Bleeding Risk	Antiplatelet / Anticoagulant Risk	Medical or Physiologic (Variable) Risk	Total Risk
EPIDURALS						
Caudal epidural injection	3	2	2	1	2	10
Lumbar interlaminar epidural injection at L5-S1	3	3	1	1	2	10
Lumbar interlaminar epidural injection above L5	4	3	3	3	2	15
Thoracic interlaminar epidural injection	4	4	4	4	2	18
Cervical interlaminar epidural injection	4	4	4	4	2	18
Lumbar transforaminal epidural injection at L3, L4, L5, and S1	2	2	1	1	2	8
Lumbar transforaminal epidural injection at L1 and L2	3	3	2	2	2	12
Thoracic transforaminal epidural injection	3	3	2	2	2	12
Cervical transforaminal epidural injection	3	3	2	2	2	12
Caudal epidural adhesiolysis	3	3	2	2	2	12
Percutaneous adhesiolysis with transforaminal approach in lumbar, thoracic, and cervical spine	4	4	2	2	2	14
Percutaneous adhesiolysis with interlaminar approach in lumbar, thoracic, and cervical spine	4	4	4	4	2	18
FACET JOINT INTERVENTIONS						
Lumbar medial branch and L5 dorsal ramus blocks	2	2	1	1	1	7
Thoracic medial branch blocks	2	2	1	1	1	7
Cervical medial branch blocks	2	2	1	1	1	7
Lumbar intraarticular injections	2	2	1	1	1	7
Thoracic intraarticular injections	2	2	1	1	1	7
Cervical intraarticular injections	2	2	1	1	1	7
Lumbar radiofrequency neurotomy	2	2	1	1	1	7
Thoracic radiofrequency neurotomy	2	2	1	1	1	7
Cervical radiofrequency neurotomy	2	2	1	1	1	7

Table 5 cont. *Risk stratification of interventional techniques based on anatomical risk factors, procedural risk factors, bleeding risk, antiplatelet/anticoagulant risk, and medical or physiological status.*

	Anatomical Risk Factors	Procedural Risk Factors	Bleeding Risk	Antiplatelet / Anticoagulant Risk	Medical or Physiologic (Variable) Risk	Total Risk
SACROILIAC JOINT INTERVENTIONS						
Sacroiliac joint injections/ nerve blocks	1	1	2	1	1	6
Sacroiliac joint nerve radiofrequency	1	1	2	1	1	6
Sacroiliac joint fusion	4	4	1	3	2	14
MINOR PROCEDURES						
Trigger point and intramuscular injections (including piriformis injection)	1	1	1	1	1	5
Peripheral nerve blocks including mandibular and maxillary nerve blocks	1	1	1	1	1	5
Intraarticular injections of extremity joints	1	1	1	1	1	5
SYMPATHETIC BLOCKS						
Ganglion impar blocks	1	1	1	1	2	6
Hypogastric plexus blocks	3	4	2	2	2	13
Lumbar sympathetic blocks	3	4	2	2	2	13
Celiac plexus blocks	3	4	2	2	2	13
Splanchnic sympathetic blocks	3	4	2	2	2	13
Thoracic sympathetic blocks	4	4	3	3	2	16
Stellate ganglion blocks	4	4	3	3	2	16
Trigeminal ganglion, ophthalmic division, and sphenopalatine ganglion blocks	4	4	3	4	2	17
NEUROMODULATION PROCEDURES						
Dorsal column and dorsal root ganglion stimulator trial and implantation	4	4	4	4	2	18
Intrathecal catheter and pump implant	4	4	4	4	2	18
Pocket revision and implantable pulse generator/ intrathecal pump replacement	1	1	1	2	2	7
Peripheral nerve stimulation trial and implantation of extremities	1	1	1	1	1	5
Peripheral nerve stimulation trial and implantation of medial branches	2	2	2	2	2	10
Trigeminal branch nerve blocks (mandibular, maxillary, and other branches)	2	1	1	1	1	6
Trigeminal and cranial nerve blocks and stimulation	4	4	2	4	2	16

Table 5 cont. *Risk stratification of interventional techniques based on anatomical risk factors, procedural risk factors, bleeding risk, antiplatelet/anticoagulant risk, and medical or physiological status.*

	Anatomical Risk Factors	Procedural Risk Factors	Bleeding Risk	Antiplatelet / Anticoagulant Risk	Medical or Physiologic (Variable) Risk	Total Risk
INTRADISCAL, INTERSPINOUS, AND DECOMPRESSION PROCEDURES						
Lumbar discography and intradiscal procedures	4	4	1	4	2	15
Thoracic discography and intradiscal procedures	4	4	1	4	2	15
Cervical discography and intradiscal procedures	4	4	1	4	2	15
Percutaneous and endoscopic disc decompression procedures	4	4	1	4	2	15
Vertebral augmentation (sacral, lumbar, thoracic, and cervical)	4	4	1	2	2	13
Minimally invasive lumbar decompression (MILD)	4	4	4	4	2	18
Intervertebral spinous prosthesis including lateral fusion	4	4	1	4	2	15
Intracept procedure	4	4	1	3	2	14

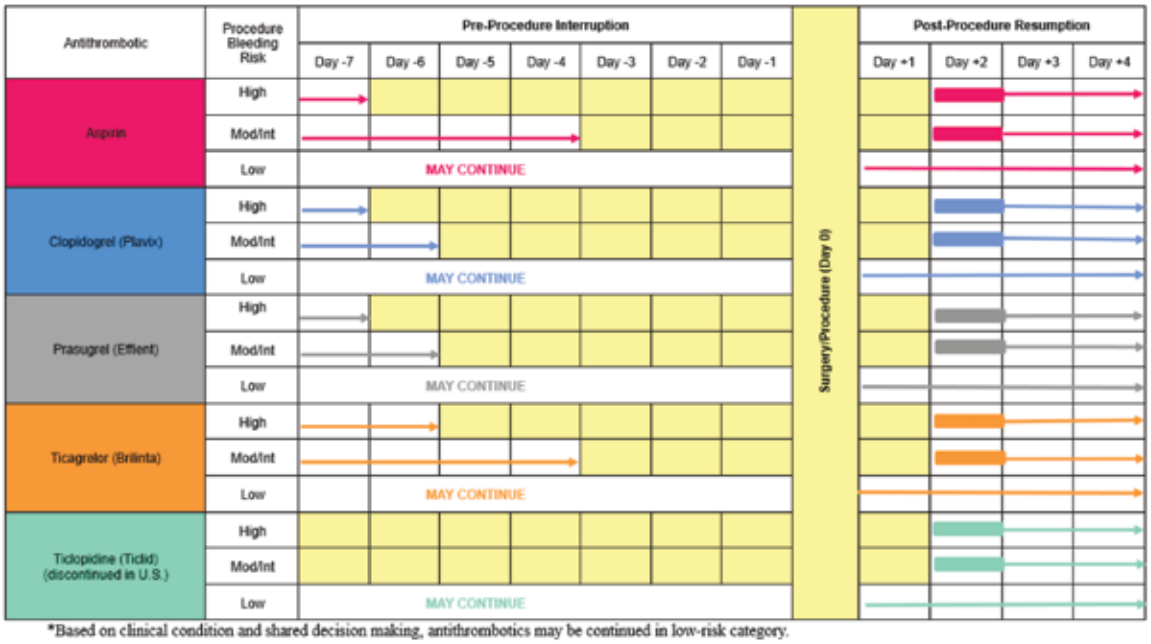


Fig. 1. *Perioperative management of antiplatelet or anticoagulant drugs for interventional procedures.*

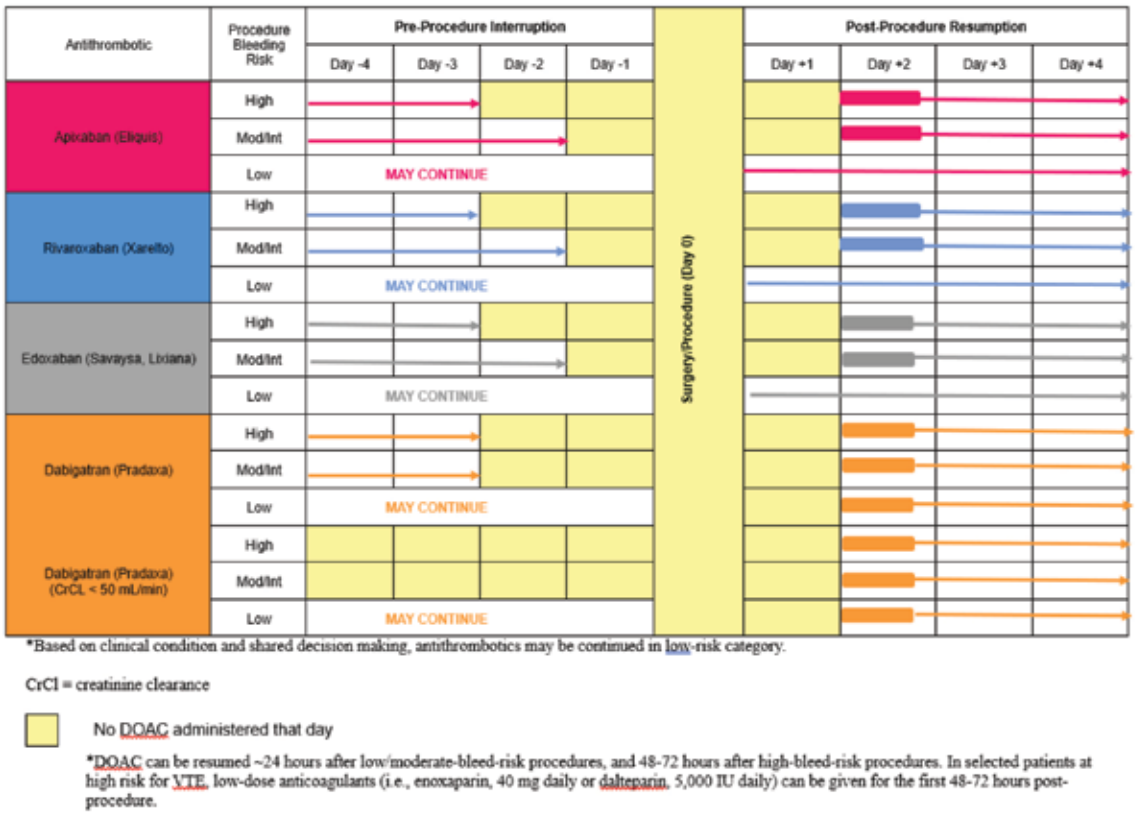


Fig. 2. *Perioperative management of interventional techniques in patients on direct oral anticoagulants (DOACs).*

often with irreversible damage resulting in significant morbidity and mortality (1,2,14-17). In addition, chronic psychosocial stress causes a hypercoagulable state; therefore, these risks are heightened in chronic pain patients with anxiety of cessation of anticoagulant and antiplatelet therapy, and associated stress and anxiety. The new guidelines published by ASIPP have provided extensive revisions to the previous societal guidelines. In addition, the guideline development also included development of risk stratification of each procedure based on anatomical risk factors, procedural risk factors, bleeding risk based on reports of epidural hematoma and other bleeding reports, and medical or physiological factors, including medical disorders leading to anticoagulant and antiplatelet therapy, age, diabetes, obesity, hypertension, vascular abnormalities with aneurysm, etc., renal and hepatic functional status with risks described to range from 1-4 in each category. Based on this assessment, multiple procedures changed their risk stratification from intermediate risk to high risk and others have changed from high risk to intermediate risk and similarly to low risk. ASRA guidelines also have updated with change of certain procedures, which were in the intermediate risk or high risk to lower risk categories. The guidance on stopping anticoagulants also has been changed. Consequently, the present practice patterns may have to change to be compliant with current literature and guidelines.

Warfarin therapy was shown to be stopped in an overwhelming majority of patients -- 80.7% for 5 days, and a further 11.4% for 7 days, with only 6.8% for 3 days. The ASIPP guidelines (15) recommend that, in patients on anticoagulant therapy with Warfarin, low risk procedures may be performed with an INR of ≤ 3.0 with 1 to 2 days of cessation if warranted, for moderate or intermediate risk procedures an INR of ≤ 2.0 is recommended with 2 to 3 days of cessation of Warfarin therapy if warranted, and for high-risk procedures an INR of < 1.5 is recommended with cessation of Warfarin therapy for 3 to 5 days if warranted.

In reference to other anticoagulants, the results show that the thrombin inhibitor dabigatran, and anti

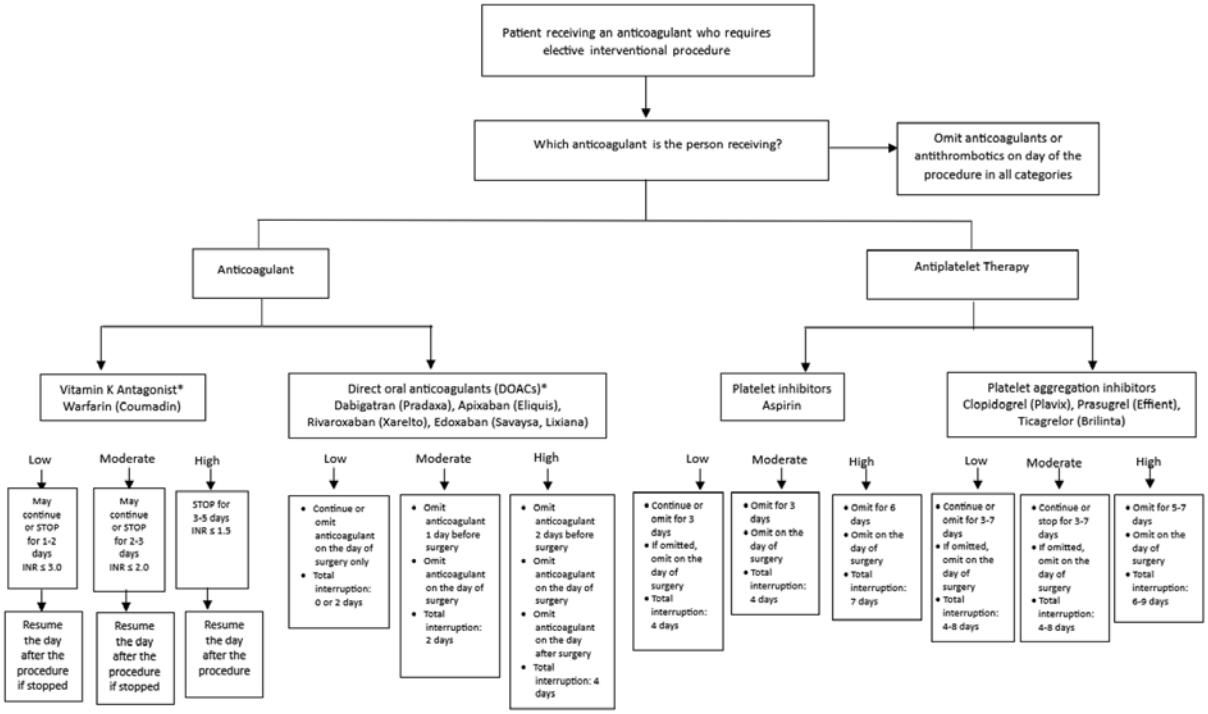
Xa agents apixaban, rivaroxaban and endoxaban were discontinued in the majority of the patients from 3-7 days; however, extensive literature shows that these anticoagulants are recommended to be discontinued for 2 days prior to the procedure for high-risk procedures and one day for intermediate-risk procedures and may be continued without interruption for low-risk procedures. Once again, it is crucial to understand these facts and follow the appropriate guidance. Figure 3 shows the schedules for interruption which is less stringent and shorter compared to the practice patterns.

Table 6 shows the risk stratification, as well as various recommendations on continuation or discontinuation of various antiplatelet and anticoagulant drugs in the perioperative period. Further, Fig. 3 shows an algorithmic approach for anticoagulant and antiplatelet discontinuation in individuals undergoing interventional procedures.

In reference to antiplatelet agents, an overwhelming majority of the physicians continued the therapy for low-risk procedures, whereas for high-risk procedures, they were discontinued from 3-7 days. This may be appropriate for high-risk procedures for Aggrenox, which also has aspirin. ASIPP recommendation is as follows:

Antiplatelet agents such as dipyridamole, cilostazol, and Aggrenox (dipyridamole plus aspirin) may be continued for low and moderate or intermediate risk procedures. For high-risk procedures, dipyridamole and cilostazol may be continued or stopped for 2 days, with Aggrenox (dipyridamole plus aspirin) to be stopped for 6 days.

In reference to platelet aggregation inhibitors, practitioners continued the therapy in a significant proportion of patients ranging from 59% to 74% with low-risk procedures; however, with high-risk



Anticoagulants:

- Vitamin K antagonists include warfarin (Coumadin)
- Direct oral anticoagulants (DOACs) include dabigatran (Pradaxa), apixaban (Eliquis), rivaroxaban (Xarelto), and edoxaban (Savaysa, Lixiana)
- Platelet inhibitors include aspirin
- Platelet aggregation inhibitors include clopidogrel (Plavix), Prasugrel (Effient), and Ticagrelor (Brilinta)

Fig. 3. *An algorithm for anticoagulant and antiplatelet discontinuation in individuals undergoing interventional procedures.*

Table 6. *Guidelines for antithrombotic medication management and interventional techniques.*

MEDICATION	Time to Wait After Last Dose of Medication Before Interventional Techniques Are Performed						Timing of Therapy Restoration or Restarting	
	LOW RISK PROCEDURES*		MODERATE OR INTERMEDIATE RISK PROCEDURES*		HIGH-RISK PROCEDURES*			
	ASIPP	ASRA	ASIPP	ASRA	ASIPP	ASRA	ASIPP	ASRA
	• Trigger point and intramuscular injections • Peripheral nerve blocks • Sacroiliac joint injections • All facet joint interventions (intra-articular injections, medial branch and L5 dorsal ramus nerve blocks and radiofrequency neurotomy) • Intraarticular injections of extremities • Pocket revision and implantable pulse generator/intrathecal pump replacement • Peripheral nerve stimulation trial and implantation of extremities • Lumbar transforaminal epidural injections at L3, L4, L5, and S1 • Ganglion impar blocks • Sacroiliac joint nerve radiofrequency • Trigeminal branch nerve blocks (mandibular, maxillary, and other branches)	• Trigger point injections • Peripheral nerve blocks • Sacroiliac joint injections • Thoracic and lumbar facet medial branch nerve block and radiofrequency ablation • Peripheral joints and musculoskeletal injections • Pocket revision pulse generator/ intrathecal pump replacement • Peripheral nerve stimulation trial and implant	• Caudal epidural injections • Caudal epidural adhesiolysis • Lumbar interlaminar epidural at L5, S1 • Cervical, thoracic, and lumbar transforaminal at L1 and L2 • Peripheral nerve stimulation trial and implantation of medial branches	• All transforaminal epidural injections • All intradiscal procedure • Sympathetic blocks • All interlaminar epidural injections • Cervical facet medial branch nerve block and radiofrequency ablation • Trigeminal and sphenopalatine ganglia blocks	• Cervical, thoracic, and lumbar (above L5) interlaminar epidurals • Trigeminal ganglion, ophthalmic division, and sphenopalatine ganglion blocks • Discography and intradiscal procedures • Dorsal column and dorsal root ganglion stimulator trial and implantation • Intrathecal catheter and pump implant • Vertebral augmentation • Percutaneous and endoscopic disc decompression procedures • Minimally invasive lumbar decompression (MILD) • Trigeminal and cranial nerve blocks and stimulation • Sympathetic blocks (stellate ganglion, thoracic sympathetic, splanchnic, celiac plexus, lumbar sympathetic, hypogastric plexus) • Percutaneous adhesiolysis with interlaminar or transforaminal approach (cervical, thoracic, and lumbar) • Intervertebral spinous prosthesis including lateral fusion • SI joint fusion • Intracept procedure	• Spinal cord stimulation trial and implant • Intrathecal catheter and pump implant • Vertebral augmentation (vertebroplasty and kyphoplasty) • Percutaneous decompression laminotomy • Epiduroscopy and epidural decompression • Dorsal root ganglion stimulation		
NSAIDS (COX 1) (COX 2)	May continue or stop 1-10 days due to lack of protective effect	Stop 1-10 days due to lack of protective effect	May continue or stop 1-10 days due to lack of protective effect	Stop 1-10 days due to lack of protective effect	May continue or stop 1-10 days due to lack of protective effect	Stop 1-10 days due to lack of protective effect	24 hours	24 hours

Table 6 cont. *Guidelines for antithrombotic medication management and interventional techniques.*

MEDICATION	Time to Wait After Last Dose of Medication Before Interventional Techniques Are Performed						Timing of Therapy Restoration or Restarting	
	LOW RISK PROCEDURES*		MODERATE OR INTERMEDIATE RISK PROCEDURES*		HIGH-RISK PROCEDURES*			
	ASIPP	ASRA	ASIPP	ASRA	ASIPP	ASRA	ASIPP	ASRA
THC/CBD	May continue or stop 1-10 days	N/A	May continue or stop 1-10 days	N/A	Stop for 5 days	N/A	24 hours	N/A
Garlic	Continue or may stop for 3 days	Stop for 4 days	Continue or may stop for 3 days	Stop for 4 days	Stop for 6 days	Stop for 6 days	24 hours	24 hours
Vitamin E	Continue or may stop for 3 days	Stop for 4 days	Continue or may stop for 3 days	Stop for 4 days	Stop for 6 days	Stop for 6 days	24 hours	24 hours
Fish Oil	Continue or may stop for 3 days	Stop for 4 days	Continue or may stop for 3 days	Stop for 4 days	Stop for 6 days	Stop for 6 days	24 hours	24 hours
Aspirin								
Low-Dose Aspirin	Continue or may stop for 3 days	Stop for 4 days	Continue or may stop for 3 days	Stop for 4 days	Stop for 6 days	Stop for 6 days	24 hours	24 hours
High Dose Aspirin	Continue or may stop for 3 days	Stop for 4 days	Continue or may stop for 3 days	Stop for 4 days	Stop for 6 days	Stop for 6 days	24 hours	24 hours
Antiplatelet Agents (Phosphodiesterase Inhibitors)								
Dipyridamole (Persantine)	May continue	May continue	May continue	May continue	May continue or stop for 2 days	Stop for 2 days	12 hours	12 hours
Cilostazol (Pletal)	May continue	May continue	May continue	May continue	May continue or stop for 2 days	Stop for 2 days	12 hours	12 hours
Aggrenox (dipyridamole plus aspirin)	May continue	Stop for 4 days	May continue	Stop for 3 days	Stop for 6 days	Stop for 6 days	24 hours	24 hours
Platelet Aggregation Inhibitors								
Clopidogrel (Plavix)	May continue	May continue	May continue or stop for 5 days	Stop for 7 days	Stop for 6 days	Stop for 7 days	12 hours	12 hours
Prasugrel (Effient)	May continue	May continue	May continue or stop for 5 days	Stop for 7-10 days	Stop for 6 days	Stop for 7-10 days	24 hours	24 hours
Ticagrelor (Brilinta)	May continue	Continue or stop 5 days	May continue or stop for 3 days	Stop 5 days	Stop for 5 days	Stop for 5 days	24 hours	24 hours
Vitamin K Antagonists								
Warfarin	May continue or stop for 1 to 2 days INR ≤ 3.0	INR < 3.0	May continue or stop for 2-3 days INR ≤ 2.0	Stop for 5 days INR normalize	Stop for 3-5 days INR ≤ 1.5	Stop for 5 days INR normalize	12-24 hours	24 hours

Table 6 cont. *Guidelines for antithrombotic medication management and interventional techniques.*

MEDICATION	Time to Wait After Last Dose of Medication Before Interventional Techniques Are Performed						Timing of Therapy Restoration or Restarting	
	LOW RISK PROCEDURES*		MODERATE OR INTERMEDIATE RISK PROCEDURES*		HIGH-RISK PROCEDURES*			
	ASIPP	ASRA	ASIPP	ASRA	ASIPP	ASRA	ASIPP	ASRA
Direct Oral Anticoagulants								
Dabigatran (Pradaxa)	May continue or stop for 1 day	May continue or stop for 4 days	Stop for 2 days	Stop for 4 days	Stop for 2 days	Stop for 4 days	24 hours	24 hours
Dabigatran (Pradaxa) (CrCl ≤ 50 ml/min)	May continue or stop for 1 day	May continue or stop for 5-6 days	Stop for 3-4 days	Stop for 5-6 days	Stop for 3-4 days	Stop for 5-6 days	24 hours	24 hours
Apixaban (Eliquis)	May continue or stop for 1 day	May continue or stop for 3 days	Stop for 1 day	Stop for 3 days	Stop for 2 days	Stop for 3 days	24 hours	24 hours
Rivaroxaban (Xarelto)	May continue or stop for 1 day	May continue or stop for 3 days	Stop for 1 day	Stop for 3 days	Stop for 2 days	Stop for 3 days	24 hours	24 hours
Edoxaban (Savaysa, Lixiana)	May continue or stop for 1 day	May continue or stop 3 days	Stop for 1 day	Stop 3 days	Stop for 2 days	Stop 3 days	24 hours	24 hours
Heparins								
Heparin (treatment) - IV	Discontinue for 4 hours	Discontinue for 6 hours	Discontinue for 4 hours	Discontinue for 6 hours	Discontinue for 4 hours	Discontinue for 6 hours	24 hours	24 hours
Heparin (treatment) - SC	Discontinue for 6 hours	Discontinue for 6 hours	Discontinue for 6 hours	Discontinue for 6 hours	Discontinue for 24 hours	Discontinue for 24 hours	24 hours	24 hours
Low Molecular Weight Heparin	Discontinue for 24 hours	Discontinue for 24 hours	Discontinue for 24 hours	Discontinue for 24 hours	Discontinue for 24 hours	Discontinue for 24 hours	24 hours	24 hours

*Change from 2019 guidelines

Adapted and modified from: Manchikanti L, et al. Epidural interventions in the management of chronic spinal pain: American Society of Interventional Pain Physicians (ASIPP) comprehensive evidence-based guidelines. *Pain Physician* 2021; 24:S27-S208 (1) and Kaye AD, et al. Responsible, safe, and effective use of antithrombotics and anticoagulants in patients undergoing interventional techniques: American Society of Interventional Pain Physicians (ASIPP) guidelines. *Pain Physician* 2019; 22:S75-S128 (14) and Narouze S, et al. Interventional spine and pain procedures in patients on antiplatelet and anticoagulant medications (Second Edition): Guidelines from the American Society of Regional Anesthesia and Pain Medicine, the European Society of Regional Anaesthesia and Pain Therapy, the American Academy of Pain Medicine, the International Neuromodulation Society, the North American Neuromodulation Society, and the World Institute of Pain. *Reg Anesth Pain Med* 2018; 43:225-262 (16).

procedures, they were discontinued from 3-7 days in almost all patients with moderate or intermediate-risk procedures falling in between. This is in compliance with ASIPP guidelines. ASIPP recommendations are as follows:

Antiplatelet therapy with clopidogrel (Plavix) and prasugrel (Effient) are discontinued for 6 days for high-risk procedures and intermediate or moderate risk procedures. They are continued in low-risk procedures. Ticagrelor (Brilinta) is discontinued for 5 days in high risk. Ticlopidine (Ticlid) (discontinued in the U.S.) is discontinued for 7 days for high and moderate or intermediate risk procedures and 3 days in moderate risk procedures and may be continued in low-risk procedures.

In summary ASIPP statements and recommendations are as follows:

1. The risk of thromboembolic events and associated morbidity and mortality is higher than that of epidural hematoma formation and associated morbidity and mortality with critical management, with the interruption of antiplatelet and anticoagulant therapy preceding interventional techniques, though both risks are significant.
   Evidence Level: Moderate; Strength of Recommendation: Moderate
2. Risk stratification categorized multiple interventional techniques into low-risk, moderate or intermediate risk, and high-risk.
   Evidence Level: Low to moderate; Strength of Recommendation: Moderate to strong
3. Risk stratification of patients undergoing interventional techniques on antiplatelet or anticoagulant therapy based on anatomical risk factors, procedural risk factors, bleeding risk factors, anticoagulant risk factors, and medical or physiological status provide a physiologic and clinically appropriate basis in developing the developing the guidelines.
   Evidence Level: Moderate; Strength of Recommendation: Moderate
4. Risk factors with severe degenerative arthritis with or without spinal stenosis, ankylosing spondylitis, osteoporosis, older age, frailty, previous stroke, intracranial bleed, hypertension, diabetes, thrombocytopenia, chronic renal failure, chronic NSAID or steroid therapy, multiple attempts, epidural fibrosis, and previous surgery may increase bleeding observed during the procedure and risk of epidural hematoma.
   Evidence Level: Moderate; Strength of Recommendation: Moderate
5. Risk stratification should be upgraded to low to moderate or intermediate and moderate or intermediate to high based on other risk factors.
   Evidence Level: Low; Strength of Recommendation: Low to Moderate
6. All procedures categorized as high-risk include:
   a. Cervical, thoracic, and lumbar (above L5) interlaminar epidurals
   b. Trigeminal ganglion, ophthalmic division, and sphenopalatine ganglion blocks
   c. Discography and intradiscal procedures (lumbosacral, cervical, and thoracic)
   d. Dorsal column and dorsal root ganglion stimulator trial and implantation
   e. Intrathecal catheter and pump implant
   f. Vertebral augmentation (sacral, lumbar, thoracic, and cervical)
   g. Percutaneous and endoscopic disc decompression procedures
   h. Minimally invasive lumbar decompression (MILD)
   i. Trigeminal and cranial nerve blocks and stimulation
   j. Sympathetic blocks (stellate ganglion, thoracic sympathetic, splanchnic, celiac plexus, lumbar sympathetic, hypogastric plexus)
   k. Percutaneous adhesiolysis with interlaminar or transforaminal approach (cervical, thoracic, and lumbar)
   l. Intervertebral spinous prosthesis including lateral fusion
   m. Sacroiliac joint fusion
   n. Intracept procedure
   Evidence Level: Moderate; Strength of Recommendation: Moderate
7. Procedures categorized as moderate or intermediate-risk include:
   a. Caudal epidural injections
   b. Caudal epidural adhesiolysis
   c. Lumbar interlaminar epidural injection at L5, S1
   d. Cervical, thoracic, and lumbar transforaminal at L1 and L2
   e. Peripheral nerve stimulation trial and implantation of medial branches
   Evidence Level: Moderate; Strength of Recommendation: Moderate
8. Procedures categorized as low-risk include:
   a. Trigger point and intramuscular injections (including piriformis injection)

b. Peripheral nerve blocks including mandibular and maxillary nerve blocks
c. Sacroiliac joint and ligament injections and nerve blocks
d. Facet joint interventions (intra-articular injections, medial branch and L5 dorsal ramus nerve blocks and radiofrequency neurotomy)
e. Intraarticular injections of extremity joints
f. Pocket revision and implantable pulse generator/intrathecal pump replacement
g. Peripheral nerve stimulation trial and implantation of extremities
h. Lumbar transforaminal epidural injections at L3, L4, L5, and S1
i. Ganglion impar blocks
j. Sacroiliac joint nerve radiofrequency
k. Trigeminal branch nerve blocks (mandibular, maxillary, and other branches)

Evidence Level: Moderate; Strength of Recommendation: Moderate

9. Discontinuation of aspirin (81 or 325 mg) for 6 days for high-risk procedures. The clinician may choose to continue aspirin (81 or 325 mg) without interruption for low and moderate or intermediate risk procedures or discontinue (81 or 325 mg) for 3 days. Similarly, additional factors may increase the risk and necessitate change in the guidance for low and moderate or intermediate risk patients.
   Evidence Level: Moderate; Strength of Recommendation: Moderate
10. Discontinuation of most NSAIDs, excluding aspirin, for 1 to 2 days and some 4 to 10 days may be considered of moderate and high-risk procedures.
    Evidence Level: Low; Strength of Recommendation: Weak
11. In patients on anticoagulant therapy with Warfarin, low risk procedures may be performed with INR of ≤ 3.0 with 1 to 2 days of cessation if warranted, for moderate or intermediate risk procedures an INR of ≤ 2.0 is recommended with 2 to 3 days of cessation of Warfarin therapy if warranted, and for high-risk procedures an INR of <1.5 is recommended with cessation of Warfarin therapy for 3 to 5 days if warranted.
    Evidence Level: Moderate; Strength of Recommendation: Moderate
12. Anticoagulant therapy with direct acting anticoagulants dabigatran (Pradaxa), apixaban (Eliquis), rivaroxaban (Xarelto), and Edoxaban (Savaysa, Lixiana) is discontinued for 2 days for high-risk procedures and one day for moderate or intermediate risk procedures. Discontinuation is adjusted to 2 days and 3-4 days for dabigatran (Pradaxa) with creatinine clearance below 50 mL/minute. For low-risk procedures, direct acting oral coagulants may be continued. Based on clinical condition and importance, a shared decision may be made to continue for moderate or intermediate risk procedures with normal renal function.
    Evidence Level: Moderate; Strength of Recommendation: Moderate
13. Antiplatelet agents such as dipyridamole, cilostazol, and Aggrenox (dipyridamole plus aspirin) may be continued for low and moderate or intermediate risk procedures. For high-risk procedures, dipyridamole and cilostazol may be continued or stopped for 2 days, with Aggrenox (dipyridamole plus aspirin) to be stopped for 6 days.
    Evidence Level: Low; Strength of Recommendation: Moderate
14. Antiplatelet therapy with clopidogrel (Plavix) and prasugrel (Effient) are discontinued for 6 days for high-risk procedures and 5 days for intermediate or moderate risk procedures. They are continued in low-risk procedures. Ticagrelor (Brilinta) is discontinued for 5 days in high risk. Ticlopidine (Ticlid) (discontinued in the U.S.) is discontinued for 7 days for high and moderate or intermediate risk procedures and 3 days in moderate risk procedures and may be continued in low-risk procedures.
    Evidence Level: Moderate; Strength of Recommendation: Moderate
15. Timing of therapy of restoration or restarting is recommended during 12 to 24-hour period for moderate or intermediate risk procedures, and low risk procedures if the decision was made to hold based on risk factors, and 24-48 hours for major risk procedures, based on postoperative bleeding status. If thromboembolic risk is high, antithrombotic therapy may be resumed 12 hours after the interventional procedure is performed, with appropriate assessment and monitoring for clinically significant bleeding.
    Evidence Level: Low; Strength of Recommendation: Moderate
16. Diagnosis of epidural hematoma is clinically based on unexpected pain at the site of the injection with rapid neurological deterioration and MRI confirmation. Neurosurgical consult is necessary to avoid neurological sequelae.

Evidence Level: Moderate; Strength of Recommendation: Moderate

17. If thromboembolic risk is high, low molecular weight heparin bridge therapy can be instituted during cessation of the anticoagulant, and the low molecular weight heparin can be discontinued 24 hours before the pain procedure.
    Evidence Level: Low; Strength of Recommendation: Weak
18. Shared decision making between the patient, the pain specialist, and the treating physicians if cessation is contemplated is recommended for consideration of all the appropriate risks associated with continuation or discontinuation of antiplatelet or anticoagulant therapy.
    Evidence Level: Moderate; Strength of Recommendation: High

Conclusion

The present survey of practice patterns of perioperative management of antiplatelet and anticoagulant therapy in interventional pain management provides insights into the management patterns; however, these are not in close approximation with recent guidelines and literature. Dissemination of guidelines may provide future directions and compliance. Ultimately, the decision to continue or stop anticoagulants is based on a physician/patient assessment of the risks and benefits of the interventional pain procedure coupled with an assessment of the underlying condition.

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Author Contributions

The study was designed by LM and VP. Statistical analysis was performed by VP. All authors contributed to the preparation of the manuscript, reviewed, and approved the content with final version.

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