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Review Article

Risks and Benefits of Ceasing or Continuing Anticoagulant Medication for Image-Guided Procedures for Spine Pain: A Systematic Review

Clark C. Smith, MD, MPH,* Byron Schneider, MD,† Zachary L. McCormick, MD,‡ Jatinder Gill, MD,§ Vivek Loomba, MD,¶ Andrew J. Engel, MD,‖ Belinda Duszynski,‖‖ and Wade King, MMedSc MMed(Pain),; on behalf of the Standards Division of the Spine Intervention Society**

*Columbia University College of Physicians and Surgeons, New York, New York; †Vanderbilt University, Nashville, Tennessee; ‡University of California at San Francisco, San Francisco, California; §Beth Israel Deaconess Medical Center, Boston, Massachusetts; ¶Henry Ford Health System, Detroit, Michigan; ‖Affordable Pain Management, Chicago, Illinois; ‖‖Spine Intervention Society, Hinsdale, Illinois, USA; **Manning Pain Management, Mayo Private Hospital, Taree, New South Wales, Australia

Correspondence to: Clark C. Smith, MD, MPH, 180 Fort Washington Ave. Ste 199, New York, NY, USA. Tel: 212-305-3535; Fax: 212-342-8472; E-mail: cs3028@columbia.edu.

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Abstract

Objective. To determine the risks of continuing or ceasing anticoagulant or antiplatelet medications prior to image-guided procedures for spine pain.

Design. Systematic review of the literature with comprehensive analysis of the published data.

Interventions. Following a search of the literature for studies pertaining to spine pain interventions in patients on anticoagulant medication, seven reviewers appraised the studies identified and assessed the quality of evidence presented.

Outcome Measures. Evidence was sought regarding risks associated with either continuing or ceasing anticoagulant and antiplatelet medication in patients having image-guided interventional spine procedures. The evidence was evaluated in accordance with the Grades of Recommendation, Assessment, Development, and Evaluation system.

Results. From a source of 120 potentially relevant articles, 14 provided applicable evidence. Procedures involving interlaminar access carry a nonzero risk of hemorrhagic complications, regardless of whether anticoagulants are ceased or continued. For other procedures, hemorrhagic complications have not been reported, and case series indicate that they are safe when performed in patients who continue anticoagulants. Three articles reported the adverse effects of ceasing anticoagulants, with serious consequences, including death.

Conclusions. Other than for interlaminar procedures, the evidence does not support the view that anticoagulant and antiplatelet medication must be ceased before image-guided spine pain procedures. Meanwhile, the evidence shows that ceasing anticoagulants carries a risk of serious consequences, including death. Guidelines on the use of anticoagulants should reflect these opposing bodies of evidence.

Key Words. anticoagulant; spine; intervention; epidural; antiplatelet; hematoma

Introduction

Image-guided interventional procedures are used to diagnose or treat back, neck, and radicular pain. Patients undergoing these procedures often have

comorbidities such as cerebrovascular or cardiovascular disorders that require the use of antiplatelet or anticoagulant medications. For invasive, interventional pain procedures, these medications may increase the risk of hemorrhagic complications. The question that arises is whether anticoagulant medications should be continued or withheld when various pain procedures are performed.

Possible hemorrhagic complications of interventional spine procedures range from a potentially catastrophic epidural hematoma to minor injection site oozing. Theoretically, risks of different bleeding complications should differ among various interventional spine procedures. Although there is a risk of epidural hematoma in procedures where the epidural space is accessed, there is no mechanism by which a properly performed extraspinal injection such as a sacroiliac (SI) joint injection, medial branch block, or intra-articular facet joint injection could cause an epidural hematoma. Other bleeding complications such as paraspinal hematoma or injection site oozing may occur in injections performed outside of the spinal canal.

The 2015 guidelines of the American Society of Regional Anesthesia (ASRA) explicitly recommend that anticoagulants be stopped prior to many interventional pain procedures [1]. While these guidelines provide an excellent summary of relevant pharmacology, their recommendations related to interventional spine procedures are not so clearly based on published evidence related to adverse events.

Some physicians have expressed concerns that stopping anticoagulant medication for interventional spine procedures may lead to an increased rate of thrombo-embolic events [2]. Prior studies in general medical practice have shown that after cessation of therapeutic anticoagulation, the risk of stroke may be two to three times greater, and the risk for other major vascular events is approximately five to six times greater [3,4].

Without evidence-based assessment of the risks and benefits of ceasing or continuing anticoagulants prior to image-guided spine procedures, decision-making between patients and physicians is based on incomplete information. Therefore, the Spine Intervention Society (SIS) assembled a task force to collect and assess the evidence concerning the safety or lack thereof of image-guided spine pain procedures in patients taking anticoagulant medications. This review reports the results of that exercise.

Methods

A literature search was performed in both PubMed and EMBASE for articles published January 1948 through June 2016, using each of the following keyword search strategies:

1. bleeding risk: (bleeding OR hematoma) AND (injection OR denervation OR ablation OR neurotomy) AND spine;

2. spinal hematoma AND injection;

3. cardiovascular risks: (stroke OR myocardial infarction OR cardiovascular event OR cerebrovascular event OR thrombosis OR embolism OR blood clot) AND (injection OR denervation OR ablation OR neurotomy) AND spine.

When suitable papers were retrieved, their bibliographies were reviewed for relevant citations that had not been identified by the database searches.

The titles and abstracts of articles generated by the literature search were screened by two of the authors (CS and BD) for prima facie potential relevance or lack thereof, using the following criteria. The same criteria were subsequently applied by the investigators who reviewed the articles selected.

To be accepted for review, articles needed to report a complication attributable both to an image-guided spine pain procedure and the use of anticoagulants; to report the incidence or prevalence of such complications; to report thrombo-embolic complications in patients who ceased anticoagulants; or to report the absence of complications in a series of patients undergoing a spine pain procedure who were either taking, continuing, or ceasing anticoagulants during the conduct of that procedure.

Articles were excluded if they met one of the following criteria; report of noncatastrophic complications, such as local bleeding or paraspinal hematoma; report of thrombo-embolic events not attributable to the use or cessation of anticoagulants; lack of sufficient information to allow conclusions to be drawn; lack of clarity regarding whether anticoagulants were continued or ceased; or lack of clarity regarding the cause of hemorrhagic or thrombo-embolic complications.

Seven reviewers formally trained in evidence-based medicine and specializing in spine care assessed the articles selected for review. Each article was evaluated to determine if it provided information on the occurrence of a complication linked to the procedure performed and if that complication could be attributed to the continuation or the cessation of anticoagulant or antiplatelet agents.

Additionally, reviewers determined if articles provided data to estimate the risk of a complication. Risk was calculated as the prevalence of a complication in a consecutive series of patients, adjusted for sample size by the 95% confidence interval of a proportion. For articles reporting a zero prevalence of complications, the reviewers adopted the upper 95% confidence limit of that zero proportion as the highest likely risk of the

complication. For this calculation, the method of Wilson was used as it is deemed appropriate for small magnitudes of prevalence [5].

Thereafter, the resultant body of evidence was assessed using the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) system to determine the quality of the evidence [6,7]. In essence, the GRADE system asks reviewers to evaluate the body of evidence transparently with consideration not only to study design, but also to attributes that would strengthen or weaken confidence in the estimate of effect. GRADE provides an initial rating of quality based on the best available evidence that comprises the body of knowledge, then further requires consideration of weaknesses (e.g., risk of bias, indirectness) that merit downgrading, as well as strengths (e.g., large magnitude of effect, dose-response gradient) that would justify upgrading the rating of the quality of the body of evidence. The published data on both the risks of continuing and ceasing anticoagulation prior to interventional spine procedures were taken into account, and overall conclusions were drawn in accordance with the GRADE system.

Results

A total of 2,657 articles were identified by electronic search of the literature, of which 213 articles were duplicates (identified by both the bleeding and cardiovascular risk searches). Review of the titles and abstracts of these 2,444 articles identified 54 articles of potential relevance to bleeding complications and 20 related to cardiovascular events. Review of the reference lists of the systematic reviews and primary studies identified by the initial literature search identified an additional 46 potentially relevant articles. All authors reviewed these studies.

Most articles failed to satisfy the inclusion criteria and were subsequently excluded. Others, whose titles appeared to promise relevance, were excluded for specific reasons. Three articles were excluded for lack of sufficient evidence upon which to draw conclusions [8–11]. Other articles were excluded because the patients described were not taking any anticoagulants [12,13]; insufficient information was reported to determine whether therapeutic anticoagulation was ceased or continued [14,15]; the cause of the complication was unclear [16]; the articles did not disclose whether the patient was on anticoagulants; or the articles did not report for how long medications had been stopped [17,18]. Reports of bleeding due to clearly improper needle placement were excluded as well [19,20]. Reports of thrombo-embolic complications due to the injection of particulate steroids were also excluded [21–24].

A large observational study that showed no major bleeding in a cohort of patients undergoing medial branch blocks was excluded because it was unclear whether these patients were on therapeutic anticoagulation [25]. Another large study showed no major bleeding complications after facet joint injections but was likewise excluded for lack of clarity as to whether patients were taking therapeutic anticoagulant medications [26].

The remaining accepted literature provided information in three domains: 1) reports of hemorrhagic complications in patients undergoing spine pain procedures and either continuing or ceasing anticoagulants; 2) reports of the purported safety of spine procedures in anticoagulated patients; and 3) reports of adverse events in patients who ceased anticoagulants.

Hemorrhagic Complications

No reports of hemorrhagic complications were found at any segmental level for transforaminal injections, medial branch blocks, sacral lateral branch blocks, injections into zygapophysial joints or the SI joint, or radiofrequency neurotomy. Hemorrhagic complications attributable to a spine pain procedure were exclusively reported for interlaminar procedures, being injections of steroids performed at various segmental levels, and either placement or removal of spinal cord stimulator leads (Table 1).

Three case reports describe catastrophic bleeding as a complication of cervical interlaminar injection of steroids (Table 1). It was not clear whether the injection was image-guided or not in the first case [27], but the injection was image-guided in the other two cases [28,29]. In the first case, an epidural hematoma caused lasting paralysis in a patient who continued to take clopidogrel, diclofenac, and aspirin during the epidural injection [27]. In the other two cases, anticoagulants were ceased in accordance with guidelines. One patient had stopped an aspirin-containing product (Fiorinal) seven days prior to the procedure and developed a subdural hematoma and lasting paralysis after the procedure [28]. The other patient had stopped clopidogrel and developed an epidural hematoma but did not suffer lasting neurologic impairment [29].

One case report described an epidural hematoma resulting in paraplegia after image-guided thoracic interlaminar corticosteroid injection [30]. The patient had stopped warfarin for seven days and was bridged with enoxaparin 1 mg/kg twice daily, which was discontinued 24 hours prior to the procedure. On the day of the procedure, the patient's international normalized ratio (INR) was 1.00. She remained on aspirin 81 mg/d for the procedure. The patient continued to have severe neurologic deficit despite surgical decompression.

Three cases of epidural hematoma have been reported following image-guided, lumbar interlaminar injection of steroids (Table 1) [31–33]. In all cases, patients were taking warfarin, which was stopped days prior to the procedure. In two of the cases, INR was checked prior to the procedure and found to be 1.2 and 1.0, respectively [31,33]. In one case, INR was not checked after warfarin was held for six days [32]. In two cases, the patient was

Table 1 Reports of hemorrhagic complications during spine pain procedures

Reference	Procedure(s)	Bleeding Complication(s)	Anticoagulation Status	Intervention/Outcome
Cervical				
Benzon et al. [27]	"Cervical epidural steroid injection" Image guidance not specified	C2-7 epidural hematoma Presenting as incomplete quadriplegia	Continued on "diclofenac, clopidogrel, and possibly aspirin"	Cervical decompression and hematoma evacuation Lower extremities remained paralyzed
Reitman et al. [28]	Image-guided C4-C5 interlaminar ESI	C2-6 subdural hematoma Presenting as incomplete quadriplegia	Fiorinal (containing aspirin) stopped for 7 d	Cervical decompression Partial motor recovery initially Postoperative course complicated by meningitis, patient died from cardiopulmonary arrest postoperative day 8
Benyamin et al. [29]	Image-guided C7-T1 interlaminar ESI	"C3 to upper thoracic" epidural hematoma	Clopidogrel stopped for 12 d	Cervical decompression resulting in resolution of neurologic symptoms
Thoracic:				
Loomba et al. [30]	Image-guided T9-10 interlaminar ESI	Thoracic epidural hematoma Presenting on postop day 6 with numbness and weakness in bilateral lower extremities	Coumadin stopped for 7 d, bridged with enoxaparin until 24 h prior to injection; coagulation profile normal prior to procedure Continued aspirin 81 mg	Thoracic decompression No significant resolution of symptoms, persistent complete thoracic spinal cord injury
Lumbar:				
Ain et al. [31]	Image-guided L4-5 interlaminar ESI	L1-5 epidural hematoma Presenting as pain, urinary retention, numbness/weakness in lower extremities	Coumadin held 6 d prior, enoxaparin bridge until 24 h before ESI INR 1.2 on day of injection, no other labs reported	Lumbar decompression At 1 wk after decompression, reported to have "mild intermittent low back pain and numbness in her toes on the left"
Xu et al. [32]	"Lumbar ESI with loss of resistance technique" Image guidance not specified	Lumbar epidural hematoma Presenting as pain and bladder retention	Warfarin stopped 6 d preprocedure, placed on enoxaparin bridge, with last dose given 30 h preprocedure Peri-procedure coagulation labs, including INR, not reported Aspirin stopped 6 d preprocedure	Lumbar decompression Resolution of symptoms

(continued)

Table 1 Continued

Reference	Procedure(s)	Bleeding Complication(s)	Anticoagulation Status	Intervention/Outcome
Page et al. [33]	Image-guided L3-4 interlaminar ESI	Epidural hematoma at L3-4 radiating to L4-5 Presenting as foot drop, urinary retention, and severe radicular pain	Coumadin held for 7 d; INR 1.0 on day of procedure	Lumbar decompression 2 y postoperation, there was "little change in the bilateral foot drop," but bowel and bladder function mostly recovered
Spinal Cord Stimulator:				
Buvanendran et al. [34]	Percutaneous spinal cord stimulator trial and lead removal	T2-T10 epidural hematoma Severe pain in low back and bilateral lower extremities during trial accompanied by cessation of stimulation sensation, prompting immediate lead removal, followed by lower extremity weakness 90 minutes postremoval	Daily aspirin 81 mg therapy continued	T5-T10 laminectomy and hematoma evacuation 7 h after symptom onset Complete resolution of symptoms
Giberson et al. [35]	Removal of percutaneous spinal cord stimulator trial leads	Patient 1: T5-L2 epidural hematoma Struggled to sit up immediately after lead removal, complained of severe back pain, followed quickly by paraparesis Patient 2: T8-L3 epidural hematoma 45 minutes after lead removal, reported acute lower thoracic pain and lower extremity weakness	Patient 1: Excedrin (containing aspirin) taken on the morning of procedure Patient 2: regular 81 mg aspirin, discontinued 11 d before lead removal	Patient 1: immediate intravenous steroids, "laminectomy and hematoma evacuation" 2 d after presentation "Permanent weakness in his left leg" Patient 2: immediate T8-L1 laminectomy and hematoma evacuation Complete resolution of symptoms

ESI = epidural steroid injection; INR = international normalized ratio.

bridged with enoxaparin 1 mg/kg [31,32]. In the third case, warfarin was held without low–molecular weight heparin bridging. Two of the patients did not suffer permanent neurologic damage [31,32], but the third suffered permanent bilateral foot drop [33].

Additional evidence pertaining to interlaminar procedures was found in the literature on spinal cord stimulators (Table 1). One patient who was taking aspirin 81 mg per day suffered an epidural hematoma after placement of a spinal cord stimulator lead, although with no lasting neurologic consequences [34]. A case series reported two patients who developed epidural hematomas after removal of stimulation leads [35]. One patient continued to take aspirin, including on the morning of the procedure, whereas the other patient had stopped aspirin for seven days. The patient who continued aspirin suffered permanent neurologic injury. A large study of bleeding complications after percutaneous spinal cord stimulator procedures included 101 procedures

in patients in whom nonsteroidal anti-inflammatory drugs and aspirin were continued with no bleeding complications [36]. The 95% confidence interval of this zero prevalence is 0% to 3.7% due to small sample size, limiting a meaningful estimate of zero or low risk.

Estimates of Safety

Several large observational studies [37–39] reported no cases of major bleeding in various numbers of patients who continued anticoagulants while undergoing various spine pain procedures (Table 2).

For radiofrequency neurotomy and various cervical procedures, the numbers of patients monitored were too small to provide a meaningful estimate of zero risk. For other procedures, however, more substantial samples of patients were monitored.

Studies have attempted to estimate the prevalence of bleeding complications among patients who underwent lumbar transforaminal injections while continuing anticoagulant and antiplatelet medications. One study found no bleeding complications in 90 cases in which anticoagulant and antiplatelet drugs were continued [37]. Another larger study reported no complications in 955 patients who continued anticoagulants and none in 663 patients who continued antiplatelet medications (Table 2) [38]. These figures indicate that the 95% confidence interval for hemorrhagic complications is 0.0% to 0.4% when continuing anticoagulants and 0.0% to 0.6% when continuing antiplatelet medications.

There are no reports of bleeding complications among patients who continued therapeutic anticoagulation for lumbar medial branch blocks. Endres et al. (2016) [38] reported no complications in 1,142 patients who continued anticoagulants during lumbar medial branch blocks or in 925 who continued antiplatelet medications. When calculating 95% confidence intervals, these figures indicate a risk of hemorrhagic complications of less than 0.3% for continuing anticoagulants and less than 0.4% for continuing antiplatelet medications.

Among patients who underwent SI joint blocks, there were no complications in 174 who continued anticoagulants or in 85 who continued antiplatelet medications [38]. The upper limits of the 95% confidence intervals for the respective risks of hemorrhagic complications, such as paraspinal hematoma, were 2.2% and 4.3%.

For lumbar facet intra-articular injections, one study found no complications among 58 injections where therapeutic anticoagulant and antiplatelet medications were continued [37]. Another study encountered no bleeding complications in 1,109 patients who continued antiplatelet medications during intra-articular injections of the lumbar zygapophysial joints (Table 2) [39]. This constitutes a risk for epidural hematoma of less than 0.3%. Table 2 includes a list of all anticoagulants and antiplatelet agents used in the above studies.

Medical Complications

The literature contains two case reports of medical complications in patients who ceased anticoagulants prior to a spine pain procedure (Table 3) [40,41]. One patient developed a pulmonary embolism after stopping warfarin in preparation for a spinal cord stimulator trial [40]; the other patient suffered a middle cerebral artery stroke after discontinuing warfarin for a lumbar epidural injection of steroids [41].

One large retrospective study monitored 2,218 cases in which anti-thrombotic therapy was stopped (Table 3) [39]. No major cardiovascular complications were encountered. In a large, prospective study, anticoagulants were ceased in 1,626 patients [38]. Nine patients suffered thrombo-embolic complications (Table 3). One died from a stroke. Another died from a myocardial infarction. Five suffered nonfatal strokes, one suffered a myocardial infarction, and one suffered a pulmonary embolism. The prevalence of these complications was nine in 1,626 (0.4%; 95% confidence interval [CI] = 0.2–0.7%). However, all events occurred in patients who ceased warfarin. The same study demonstrated no thromboembolic complications among 701 patients who stopped antiplatelet therapy [38].

GRADE Evaluation

For procedures for which there is no evidence either for risk or for safety, no conclusion about the quality of evidence is applicable. For other procedures, the quality of evidence differs according to the type of evidence available.

The evidence concerning safety of interlaminar procedures is low in quality according to the GRADE system because it is based solely on case reports. This level could be upgraded if future studies reported the prevalence of complications in prospective case series.

For lumbar transforaminal injections, lumbar medial branch blocks, and lumbar intra-articular injections, the GRADE quality of evidence is moderate as it is based on large observational studies. For SI joint injections, the quality of evidence is perhaps best regarded as low because although provided by an observational study, the sample size is small. Larger sample sizes could upgrade the quality of evidence to moderate.

Discussion

The published literature clearly shows that interlaminar procedures carry a risk of hemorrhagic complications. The magnitude of that risk is not known because no case series has provided a prevalence estimate, but it is manifestly nonzero. Indeed, the majority of case reports of hemorrhagic complications occurred in patients who ceased anticoagulant and antiplatelet medications according to the 2015 ASRA guidelines. This predominance may reflect the fact that during routine practice

Table 2 Case series of interventional spine procedures performed without ceasing anticoagulation

Reference	Procedure(s)	Bleeding Complications	Anticoagulation Status
Moeschler et al. [36]	421 patients, 642 percutaneous SCS procedures (SCS trial, revision, or implantation)	No major bleeding complications	101 procedures on patients who had taken aspirin or NSAIDs within 7 d of procedure
Goodman et al. [37]	197/4,253 procedures were performed on patients taking therapeutic anticoagulant and antiplatelet medications	One patient not taking therapeutic or antiplatelet medication suffered spinal epidural hematoma, which resolved with nonsurgical conservative care	Anticoagulant* and antiplatelet† medications were continued: 90 LTFESI 11 lumbar intradiscal injection 4 CMBB 58 lumbar facet injection 3 sympathetic paravertebral injection 3 cervical RFN 23 lumbar RFN 5 SIJ injection *Warfarin, dabigatran, apixaban, rivaroxaban †Clopidogrel, cilostazol, prasugrel, ticagrelor
Endres et al. [38]	1,383 patients, 7,062 pain procedures	No major bleeding complications	On anticoagulants* at time of procedure: 955 LTFESI 1,142 LMBB 174 SIJ injection 35 RFN 26 ILESI On antiplatelets† at time of procedure: 633 LTFESI 925 LMBB 85 SIJ injection 22 RFN 15 ILESI‡ *Warfarin, rivaroxaban, dabigatran, apixaban, enoxaparin †Aspirin/dypyridanole, clopidogrel, cilostazol, ticagrelor, prasugrel ‡Subtherapeutic only
Manchikanti et al. [39]	ESI: 2,664/10,261 patients on antithrombosis medication Facet: 2,068/7,482 on antithrombosis medication Other injections: 183/546 on antithrombosis medications	No major bleeding complications that resulted in neurologic injury	On warfarin at time of procedure: 10 ESI 7 facet procedures 2 “other” On antiplatelet* at time of procedure: 1,455 ESI 1,109 facet procedures 78 “other” *Aspirin, clopidogrel, aspirin

CMBB = cervical medial branch block; cont = continued; dc = discontinued; ESI = epidural steroid injection; facet = facet joint injection; ILESI = interlaminar epidural steroid injection; LMBB = lumbar medial branch block; LTFESI = lumbar transforaminal epidural steroid injections; RFN = radiofrequency neurotomy; SIJ = sacroiliac joint injection.

Table 3 Cardiovascular and thrombo-embolic complications attributable to discontinuing anticoagulation or antiplatelet therapy for pain procedures

Reference	Technique	Cardiovascular Complication(s)	Anticoagulation Status
Endres et al. [38]	1,383 patients, 7,062 pain procedures	9/1,626 complications when anticoagulants stopped 0/701 complications when antiplatelet stopped Complications: 2 patients died, 5 suffered strokes, 1 pulmonary embolism, 1 myocardial infarction	Anticoagulants held* at time of procedure: 505 LTFESI 458 LMBB 41 SIJ injection 309 RFN 180 ILESI Antiplatelets† held at time of procedure: 250 LTFESI 178 LMBB 6 SIJ injection 195 RFN 72 ILESI *Warfarin, rivaroxaban, dabigatran, apixaban, enoxaparin †Aspirin/dypyridanole, clopidogrel, cilostazol, ticagrelor, prasugrel
Manchikanti et al. [39]	ESI: 2,664/10,261 patients on antithrombosis medication Facet injection: 2,068/7,482 on antithrombosis medication Other injections: 183/546 on antithrombosis medications	No major cardiovascular complications reported in 2,218 cases in which antithrombosis was stopped 48-hour follow-up	Warfarin held for procedure: 182 ESI 238 facet procedures 22 “other” Antiplatelet* held procedure: 981 ESI 714 facet procedures 81 “other” *Aspirin, clopidogrel, aspirin, and others
Kumar et al. [40]	Dorsal Column Stimulator Trial	Pulmonary embolism No lasting complications	Warfarin discontinued
Linn et al. [41]	L5-S1 epidural steroid injection	Right middle cerebral artery infarction; persistent left hemiparesis, neglect, and dysarthria	Warfarin discontinued for 9 d preprocedure

cont = continued; dc = discontinued; ESI = epidural steroid injection; ILESI = interlaminar epidural steroid injection; inj = injection; MBB = medial branch block; RFN = radiofrequency neurotomy; SIJ = sacroiliac joint injection; TFESI = transforaminal epidural steroid injections.

anticoagulants are held in the vast majority of patients undergoing procedures. The occurrence of bleeding complications was not limited to any particular antiplatelet or anticoagulant. While different antiplatelet agents are associated with varying degrees of platelet inhibition, there is insufficient evidence to distinguish the risk of bleeding complications among these agents. Although the risk of hemorrhagic complications following interlaminar procedures might be small, some reported complications are severe or catastrophic. Therefore, the published evidence supports safety concerns during interlaminar procedures, regardless of whether anticoagulant and antiplatelet agents are continued or ceased.

For several other procedures, published evidence is either lacking or minimal in magnitude. There were no case reports that met inclusion criteria of hemorrhagic complications for cervical transforaminal injections, cervical medial branch blocks, or radiofrequency

neurotomy at any segmental level; conversely, no case series has provided compelling data that show that these procedures are safe in patients who continue anticoagulants. Such case series are needed before these procedures might be regarded as safe.

In contrast, the published evidence indicates that lumbar transforaminal injections, lumbar intra-articular injections, and lumbar medial branch blocks are safe and that SI joint injections might be safe, regardless of continuation of therapeutic anticoagulation or antiplatelet medication. For these procedures, there are no case reports of hemorrhagic complications. Large case series allow for the calculation of the 95% confidence interval for the true prevalence of bleeding complications. For lumbar medial branch blocks, the risk is less than 0.3% in patients continuing anticoagulants and less than 0.4% in patients continuing antiplatelet medications. For lumbar transforaminal injections, the respective risks are less than 0.4% and less than 0.6%. For lumbar intra-articular injections, the risk is less than 0.2% in patients taking antiplatelet medications. For SI injections, the risks are less than 2.2% for patients taking anticoagulants and less than 4.3% for patients taking antiplatelet medications.

Antecedent studies have established a definition of safety for spine procedures. A study concluded that lumbar epidural steroid injections are safe in patients taking anti-inflammatory drugs, on the grounds that zero hemorrhagic complications were encountered in 383 consecutive patients, for a risk of less than 0.96% [42]. One large study conducted by eminent anesthesiologists found no bleeding complications in 386 patients for a risk of 1.1%. The resulting risks of bleeding complications of 0.96% and 1.1% were considered safe by the authors [42,43].

According to these standards, lumbar medial branch blocks with a risk of 0.3% or 0.4% and lumbar intra-articular injections with a risk of 0.3% are clearly safe. So too are lumbar transforaminal injections, with a risk of either 0.4% in patients continuing anticoagulants or 0.6% in patients taking antiplatelet agents. The risk of hemorrhagic complications for SI injections (2.2–4.3%) falls short of the threshold for safety (1.0%) but might be demonstrated in a larger case series in the future.

In contrast to the safety of the aforementioned procedures, the literature records complications from ceasing anticoagulants for spine pain procedures, as currently recommended by guidelines [1]. Although small (0.4%; 0.2–0.7%), the risk of vascular and cerebrovascular complications is not negligible, and the nature of the complications is severe and potentially life-threatening. Moreover, in patients taking warfarin, the risk of vascular and cerebrovascular medical complications (0.6%; 0.32–1.15%) is almost significantly greater statistically than the risk of hemorrhagic complications in like patients undergoing lumbar medial branch blocks (0.00–0.34%), lumbar intra-articular injections (0.00–0.35%), or lumbar transforaminal injections (0.00–0.38%). These figures warn that guidelines concerning the cessation of anticoagulants need to balance the risk of hemorrhagic complications against a potentially greater risk of medical complications.

With respect to vascular and cerebrovascular complications, this focused review found no vascular or cerebrovascular complications pertaining to holding antiplatelet medications. However, there is a large body of literature that points to the real and high risk of interrupting antiplatelet therapy, especially for stent thrombosis [44,45]. This review only found vascular and cerebrovascular complications in patients who discontinued warfarin. This finding may indicate that stopping warfarin may constitute a particular risk of vascular and cerebrovascular complications. This may be due to factors relating to the agent itself or the conditions for which it is prescribed.

This review was undertaken expressly to identify the literature pertinent to anticoagulation and spine pain procedures. It was not designed to formulate guidelines or to discuss conjectures about the risks of complications in procedures about which there is no evidence. However, the evidence gathered serves to inform the directions that future guidelines might take.

For many procedures, there is no published evidence either of risk or of safety. Recommendations for these procedures would be theoretical until evidence becomes available. Interlaminar procedures carry a risk of hemorrhagic complications. In contrast, the evidence does not warrant attributing any significant risk to lumbar transforaminal injections, lumbar intra-articular injections, or lumbar medial branch blocks in anticoagulated patients. Meanwhile, ever present is the risk of serious medical complications if anticoagulant and antiplatelet medications are ceased for any spine pain procedure.

In conclusion, the evidence does not support the view that anticoagulant and antiplatelet medications must be ceased before image-guided spine pain procedures that do not involve interlaminar access. Meanwhile, the evidence shows that ceasing anticoagulants carries a risk of serious consequences, including death. Guidelines on the use of anticoagulants should reflect these opposing bodies of evidence.

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