# CAR/CAIR Practice Guidelines: Periprocedural Management of Patient Bleeding Risk

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## Abstract

These practice guidelines, developed by the Canadian Association for Interventional Radiology (CAIR) and the Canadian Association of Radiologists (CAR) with input from hematology experts, provide evidence informed, practical recommendations for managing bleeding risk during image guided procedures. Building on the 2019 Society of Interventional Radiology guideline, they streamline decision making around anticoagulation, antiplatelet therapy, laboratory testing, and transfusion thresholds for use across Canadian radiology departments. A systematic review of post 2019 evidence and expert consensus-informed updates to procedural risk stratification and clarified INR and platelet thresholds. The guidance emphasizes that most radiologic procedures carry very low bleeding risk and generally do not require routine laboratory screening or interruption of anticoagulant or antiplatelet medications, while high risk procedures warrant targeted testing and standardized transfusion thresholds, including those tailored for chronic liver disease. Special sections address lumbar puncture, arterial access, and urgent or emergent procedures. Overall, the guideline highlights individualized clinical judgment, avoidance of unnecessary delays or consultations, and careful consideration of transfusion risks, with the goal of promoting streamlined, safe, and consistent care across Canadian imaging practices.



## Résumé

Ces lignes directrices de pratique, élaborées par l'Association canadienne pour la radiologie d'intervention (ACRI) et l'Association canadienne des radiologistes (CAR) avec la contribution d'experts en hématologie, fournissent des recommandations pratiques fondées sur des données probantes pour la gestion du risque hémorragique lors des interventions guidées par imagerie. S'appuyant sur les lignes directrices de 2019 de la *Society of Interventional Radiology*, elles rationalisent la prise de décision en matière d'anticoagulation, du traitement antiplaquettaire, d'analyses de laboratoire et de seuils de transfusion à utiliser dans tous les services de radiologie canadiens. Un examen systématique des données probantes publiées après 2019 et un consensus d'experts ont permis de mettre à jour la stratification du risque procédural et de clarifier les seuils de RIN et plaquettaires. Les lignes directrices soulignent que la plupart des interventions radiologiques comportent un risque hémorragique très faible et ne nécessitent généralement pas de dépistage en laboratoire systématique ni d'interruption des médicaments anticoagulants ou antiplaquettaires, tandis que les interventions à risque élevé justifient des analyses ciblées et des seuils de transfusion normalisés, y compris ceux adaptés à la maladie hépatique chronique. Des sections spéciales traitent de la ponction lombaire, de l'accès artériel et des interventions urgentes ou émergentes. Dans l'ensemble, les lignes directrices mettent l'accent sur le jugement clinique individualisé, la prévention des retards ou des consultations inutiles et l'examen attentif des risques liés à la transfusion, dans le but de promouvoir des soins rationalisés, sûrs et uniformes dans l'ensemble des pratiques d'imagerie canadiennes.



## Keywords

interventional radiology, image-guided procedures, hemorrhage, risk assessment, anticoagulants, antiplatelet therapy, blood coagulation tests, ablation techniques, lumbar puncture, periprocedural management


## Introduction

The following guidelines were developed through a collaboration between the Canadian Association for Interventional Radiology (CAIR) and the Canadian Association of Radiologists (CAR), with invaluable input from hematology experts. The document provides practical, evidence-informed recommendations for managing bleeding risk in patients undergoing image-guided procedures.

By simplifying complex decisions around anticoagulation, antiplatelet therapy, and transfusion practices, these guidelines aim to support quality improvement and promote optimal patient care.

These guidelines are intended to cover most scenarios in a radiology department but should not be considered absolute rules. They do not replace individualized clinical judgment. Each patient's circumstances are unique, and radiologists must apply their professional judgment while considering local policies and available resources.

## Methodology

The multidisciplinary authorship panel comprised 3 hematologists (JC, MP, RS), 3 interventional radiologists (AM, LMB, RP), and 2 diagnostic radiologists with procedural experience (KH, AG), supported by a CAR staff member with expertise in guideline development (CH). The panel reviewed the 2019 Society of Interventional Radiology (SIR) guidelines with the aim of enhancing their practicality for implementation across Canadian radiology departments. Key objectives included streamlining decision-making around bleeding risk, reducing unnecessary hematology consultations, minimizing unnecessary laboratory testing and transfusions, and minimizing risks to patients.

An extensive literature review was conducted to identify evidence published since 2019, that would potentially alter the recommendations from the SIR. Of 4381 articles screened by title and abstract, 70 progressed to full-text review. An additional 21 relevant articles were identified outside the initial search. Ultimately, 68 of 91 full-text articles were included in the evidence base. Where evidence was lacking, recommendations were informed by expert consensus.

## Guiding Principles

Prediction of bleeding risk in image-guided procedures is challenging, with limited evidence to guide practice. However, several guiding principles can help simplify and improve clinical decision-making:

- **Past bleeding is the most important predictor of bleeding risk.** The most important predictor of a bleeding complication is that a patient has had a prior significant bleeding event. A prior bleeding event is a significant enough factor in decision-making that should override any other recommendations in these guidelines.
- **Laboratory tests are limited predictors of bleeding risk.** Although these guidelines attempt to provide a simple and practical set of parameters to follow, each clinical scenario is unique. Laboratory tests such as platelet levels, INR, are limited predictors. Broad use of laboratory tests should be restrained, given the costs and strain on the medical system.
- **Discontinuation of antiplatelet and/or anticoagulation medication can be more harmful to the patient than the underlying baseline procedure complication rate.** Do not ever stop a patient's antiplatelet medication without consulting their prescribing cardiologist or neurologist, if the patient has a thrombosis, PCI, ablation, coronary stent, or neurological ischemic event within the last year.
- **Complication rates for image-guided procedures in radiology are very low.** Delays or cancellations carry their own risks and costs, including postponed diagnosis and treatment. Per-procedural management of bleeding risk, antiplatelet/anticoagulant use, and blood product administration should be tailored to the patient's unique medical history and physical attributes, the urgency of the procedure, and the physician's experience and expertise.
- **There are complications associated with transfusion of blood products.** When a transfusion of a blood product is considered to minimize the risk of bleeding complications, the possibility of serious transfusion complications needs to be considered and discussed with the patient. The most common causes of transfusion-related death and major morbidity are transfusion-related acute lung injury (risk 1 in 10 000) and transfusion-associated circulatory overload (risk 1 in 100).

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**Table 1.** Classification of Procedure Risk.

| Low-risk |
|---|
| • Breast procedures (ablations, biopsies including vacuum-assisted and large-gauge, drainage insertions, localizations)<br>• Catheter exchanges (gastrostomy, biliary, nephrostomy, nephroureterostomy, ureteric stents, abscess drains, gastrostomy/gastrojejunostomy including conversions, etc.)<br>• Chest tube placement for pleural effusion (tunneled and non-tunneled)<br>• Diagnostic arteriography and arterial interventions, sheath size 6 Fr or less, all radial access<br>• Diagnostic venography and venous interventions<br>• Dialysis access interventions (fistulograms, fistula declotting, angioplasty, and stenting)<br>• Facet joint injections and medial branch nerve blocks (thoracic and lumbar spine)<br>• IVC filter placement and removal<br>• Lumbar puncture<br>• MSK injections (joints, tendons, and muscles)<br>• Nerve blocks (sacral lateral branch blocks, hypogastric, celiac plexus)<br>• Paracentesis<br>• Peritoneal drains (tunneled/non-tunneled)<br>• Superficial abscess drainage or biopsy (palpable lesion, lymph node, soft tissue, thyroid, superficial bone, eg, extremities and bone marrow aspiration)<br>• Superficial MSK ablations<br>• Suprapubic catheter insertion<br>• Thoracentesis<br>• Transjugular liver biopsy<br>• Tunneled venous catheter placement/removal (including ports)<br>• Venous access and removal (PICC, Hickman, ports, tunneled and non-tunneled dialysis line insertion) |
| **High-risk** |
| • Ablations (liver, renal, lung)<br>• Advanced thoracic venous intervention (SVC recanalization)<br>• Arterial procedures (sheath size 7 Fr or greater)<br>• Biliary procedures (PTC, biliary drain, cholecystostomy)<br>• Cervical blocks and epidural injections<br>• Deep fluid/abscess drainage<br>• Feeding catheter insertions (gastrostomy, gastrojejunostomy, direct jejunostomy)<br>• Lung biopsy, lung nodule coil localization<br>• Lumbar CSF drain insertion<br>• Nephrostomy<br>• Solid deep organ biopsy (liver, renal, prostate), deep lymph node/soft tissue biopsy (retroperitoneal, pelvic, mediastinal)<br>• Transjugular intrahepatic porto-systemic shunt (TIPS)/direct portal vein access<br>• Venous and pulmonary artery thrombectomy*<br>• Vertebroplasty/kyphoplasty |

*These patients are almost always fully anticoagulated; do not interrupt anticoagulation prior to the procedure. Follow the ISTH guidelines for platelet thresholds in patients with thrombocytopenia.[3]

- **The risk of bridging generally outweighs its benefits.** Bridging anticoagulation – using full dose anticoagulants with a short half-life during the periprocedural period, to minimize "gaps" in anticoagulation – is not recommended for most patients. Randomized trials show that withholding bridging therapy results in similar rates of clotting but significantly *less* major bleeding compared to bridging, particularly in patients who have a low-to-moderate risk of clotting.[1,2] Bridging may be considered in select high-risk populations (eg, mechanical heart valves, very recent thrombosis); an expert in thrombosis medicine should advise on these patients.

For ease of reference, Table 1 divides procedures into low-risk and high-risk of bleeding complications. Table 2 provides a summary of recommendations for periprocedural management of bleeding risk, including pre-procedural INR and platelet screening. Please see the guideline's Supplemental Material for a print-friendly summary of recommendations.

Platelet transfusions should be administered as close as possible to the procedure, ideally immediately before or during it in the imaging department once the procedure is

**Table 2.** Laboratory Testing Recommendations.

| Procedure | Normal liver function | Chronic liver disease |
|---|---|---|
| Low-risk | Platelet and INR: do not screen.<br>However, if bloodwork has already been performed:<br>INR: correct to within range of 2.0-3.0<br>Platelet: transfuse if $<20 \times 10^9$/L | Platelet and INR: do not screen.<br>However, if bloodwork has already been performed:<br>INR: N/A<br>Platelet: transfuse if $<20 \times 10^9$/L |
| High-risk | Routinely screen platelet and INR<br>INR: correct to <1.8<br>Platelets: transfuse if $<50 \times 10^9$/L | Routinely screen platelet and INR<br>INR: correct to <2.5<br>Platelet: transfuse if $<30 \times 10^9$/L |

*Note.* These recommendations are based on the 2019 Society of Interventional Radiology guidelines,[4] but have been simplified to remove fibrinogen, and to give an absolute cutoff for INR and platelets. Laboratory tests are considered valid if within 12 weeks for a stable outpatient and within 72 hours for an inpatient.

confirmed to be proceeding as planned. Platelet units are pathogen-reduced, have a small volume (180 mL), and the platelets are suspended in platelet additive solution – all 3 mitigate the risk of transfusion reactions and make them safe to transfuse in the Diagnostic Imaging Department.

For additional context regarding testing thresholds for patients with chronic liver disease, see Appendix A.

## Low-Risk Procedures

Low-risk procedures are commonly performed with the additional safety of imaging guidance. Most patients undergoing low-risk procedures in the radiology department have a very low rate of hemorrhagic complications – usually less than 1%. These procedures are considered safe to perform without the need to perform pre-procedure blood work or to routinely discontinue anticoagulant or antiplatelet medications. Patients with a prior history of bleeding or who are high-risk for bleeding (eg, bleeding disorder) may require hematology referral for pre-procedure assessment of bleeding risk. Routine preprocedural testing of INR, platelet count, or fibrinogen level are not required. If testing is performed or recently available, an INR of less than 3.0 and a platelet count above $20 \times 10^9$/L are considered acceptable thresholds (and fibrinogen level >1.0 g/L for patients with underlying liver disease). These thresholds are unchanged from prior SIR 2019 guidelines.[4]

### *Thoracentesis, Chest Tubes, and Paracentesis*

Despite traversing the pleural space, thoracentesis and nontunneled chest tubes are low-risk procedures, commonly performed in acutely ill patients. There is low bleeding risk ranging from 0.2% to 0.4% even with uncorrected lab values and continuation of antiplatelet and/or or anticoagulation.[5-8] Paracenteses are a common procedure, including in patients with cirrhosis-associated coagulopathy, and increasingly with imaging guidance. Bleeding risk is <0.2%[9] with no association established between bleeding and INR, platelet count, user experience, or image guidance.[9-12]

### *Superficial Biopsy or Abscess Drainage*

Superficial biopsy and abscess drainage refers to procedures that do not penetrate the pleural or abdominal cavities (including peritoneal and retroperitoneal spaces). These procedures typically involve:

- Palpable lesions
- Lymph nodes (neck, axilla, inguinal, or other superficial sites that can be easily compressed)
- Breast tissue
- Soft tissue
- Thyroid
- Superficial bones (including extremities)
- Bone marrow aspiration

Most of these procedures are performed using smaller gauge needles, typically ranging from 25G to 18G.[13] However, sarcoma protocols and breast biopsies require larger gauges, ranging from 14G to greater than 9G. Notably, the use of 9G needles or larger, even in patients on full-dose antiplatelet therapy, has not been associated with clinically significant bleeding in breast procedures, especially when vacuum assistance is used.[14,15]

Bone marrow biopsies carry a bleeding risk of less than 0.03%, with no observed correlation to thrombocytopenia.[16-18] There are limited data on bleeding risks for superficial lymph node and soft tissue biopsies. However, due to their superficial location, compression at the biopsy site is generally effective in managing bleeding risk. It is reasonable to extrapolate safety data from other superficial procedures to these sites. The panel consensus is to continue classifying these procedures as low-risk.

### *Suprapubic Catheter Insertion*

Percutaneous access to the bladder is extraperitoneal, in a contained space. The risk profile of suprapubic catheter insertions is therefore comparable to insertions of other superficial drains. Suprapubic catheter insertion carries an estimated bleeding risk of 0.4%.[19] In the rare scenario of bleeding post insertion, the

relatively superficial and contained potential space should allow for control of hemorrhage by applying pressure.

### Musculoskeletal Procedures

Low-risk musculoskeletal (MSK) procedures include injections, nerve blocks, trigger point injections, and joint aspirations, further detailed in Table 1. Common spine procedures, such as lumbar punctures and facet blocks, are considered low risk. Available data indicates that MSK procedures carry a bleeding risk of less than 1%.[20-22]

### Catheter Exchange or Removal

Catheter exchanges (ex. nephrostomy) are typically performed over a wire through an already established tract, which has often matured over weeks to months. Thus, it is accepted that these are low-risk. Similar rationale applies to drain removal. If there is concern regarding removal in the event of a recently placed catheter, the inserting service may be contacted for guidance. Tunneled catheters are included in this rationale, with limited available literature not supporting pre-removal lab values.[23]

### Venous Procedures

Low-risk venous procedures include diagnostic venography, select venous interventions, IVC filter placement/removal, non-tunneled venous access/removal, and tunneled venous access/removal as outlined in Table 1. These procedures are considered low-risk primarily due to the low-pressure nature of the venous system, which generally results in less significant bleeding compared to arterial procedures.

Tunneled catheter placement has been shown to be safe even in patients with elevated INR, thrombocytopenia, or taking full dose anticoagulation, with bleeding risk estimated at less than 0.5%.[24,25] For non-tunneled and peripheral catheters, the available data are of lower quality, but current evidence suggests no significant difference in bleeding risk between thrombocytopenic and non-thrombocytopenic patients.[26-28] Given this evidence, it is reasonable to extrapolate risk from tunneled catheter data. Further, a recent small study showed even in critically ill patients with severe thrombocytopenia, bleeding risk was not elevated in ultrasound guided central venous catheter placement, nor was platelet administration found to reduce risk of bleeding.[29] Recent guidance from the Association for the Advancement of Blood & Biotherapies and International Collaboration for Transfusion Medicine Guidelines indicates that platelet transfusion is recommended for patients undergoing IVC placement when platelet count is $<10$.[30]

## High-Risk Procedures

In image guided procedures, high-risk interventions include both common and rare procedure types, as listed in Table 1. The panel recommends adhering to the SIR 2019 guidelines for management of patient bleeding risk, which are summarized in Table 2. These guidelines are generally conservative, and some deviation may be appropriate in specific cases. Mounting evidence suggests that certain procedures may be safely performed while patients are on anticoagulants, and particularly while on antiplatelet therapy. These procedural variants are described below.

### Solid Organ Biopsy

Most solid organ biopsies, including those of the liver, lung, kidney, adrenal glands, and prostate are considered high-risk procedures. This classification also applies to lymph nodes that are not easily accessible or located in areas where compression for hemostasis is challenging, such as retroperitoneal, mediastinal, and deep pelvic nodes. Among these, renal biopsies carry the highest bleeding risk at 1.6%, with low platelets – but not antiplatelet use – identified as a risk factor.[31] A recent meta-analysis found no significant association between aspirin use and bleeding complications during renal biopsy.[32] Therefore, kidney biopsy may be considered in patients on aspirin when clinically indicated, regardless of dose.

Liver biopsy has an overall bleeding risk of 0.7%.[33] Low platelet counts are a known risk factor, particularly in patients with chronic liver disease.[33,34] A recent retrospective study demonstrates safety of the application of the SIR 2019 guidelines to liver biopsy, with potential applicability to other organ biopsies.[35]

### Lung Biopsy

Bleeding after percutaneous (CT-guided) lung biopsy is one of its most clinically significant complications, typically self-limited but occasionally catastrophic. A large meta-analysis reported radiographic pulmonary hemorrhage in approximately 18% and hemoptysis in 4% of cases following core needle biopsy, compared with 6.4% and 1.7%, respectively, after fine-needle aspiration (FNA).[36] Once bleeding occurs, it can be difficult to control, and even a seemingly minor amount of intrapulmonary or airway hemorrhage can be fatal in frail or hypoxemic patients.

### Ablation

Thermal ablations, including cryoablation, microwave ablation, and radiofrequency ablation, are generally considered high-risk procedures. A meta-analysis of 7 randomized studies evaluating RFA or microwave ablation for hepatocellular carcinoma (HCC) reported a bleeding risk of 0.98%.[37] Ablation techniques may cauterize the needle tract, potentially reducing bleeding risk. In certain patients where interruption of anticoagulation or antiplatelet therapy poses a significant risk (eg, mechanical heart valves, recent coronary

stents), radiologists may weigh the risks and proceed with ablation while continuing these medications. Liver ablations are frequently performed in cirrhotic patients with thrombocytopenia. A recent large study did not demonstrate an association between bleeding post-ablation and thrombocytopenia in cirrhotic patients.[38]

### Deep Collection Drainage

Drain insertion of deeper collections, particularly in locations where bleeding control by compression is difficult, is also considered a high-risk procedure. However, the evidence regarding bleeding risk is limited. Transgluteal drain insertion, which is likely among the more complex approaches, has a reported complication rate of 2%.[39]

This classification does not apply to pleural space procedures. Pleural drain insertions and thoracentesis are generally considered low-risk. In contrast, drain insertion into the lung parenchyma should be considered equivalent to lung biopsies and therefore classified as high-risk.

### Spine Procedures

Spine procedures, including vertebroplasty, kyphoplasty, ablations, biopsies, are all considered high-risk procedures, with potential risk of cord compression in the context of significant epidural bleeding. Spine biopsy bleeding complication rates are estimated at less than 1%.[40] Lumbar punctures are not to be included in the high-risk group, as described below.

### Genitourinary

Procedures involving the urinary tract, such as de novo nephrostomy tube placement, nephroureterostomy drain placement, and ureteric stone manipulation, are considered high-risk and comparable in bleeding risk to deep drain insertions. The estimated bleeding risk for percutaneous nephrostomy tube insertion ranges from 0.5% to 1.5%.[41-43] Recent evidence suggests that antiplatelet therapy does not significantly increase bleeding risk, allowing for some flexibility in discontinuation prior to nephrostomy tube placement.[44]

### Venous Interventions

Due to the low pressure of the venous circulation, almost all venous interventions are considered low-risk. Practically, the majority of these are performed with additional anticoagulation. However, venous interventions in the thorax, particularly in the context of SVC I recanalization, are best considered as high-risk. Potential bleeding in the pericardial or pleural space is more challenging to control, and warrants a more careful approach.

### Feeding Catheters

De novo insertions of feeding catheters, including gastrostomy catheters, gastrojejunostomy catheters, direct jejunostomy catheters, and more advanced procedures such as direct endoscopic ultrasound-guided gastrojejunostomy track formation, are similarly considered high-risk procedures. Evidence regarding the impact of anticoagulation and antiplatelet therapy on bleeding risk is mixed. A single-center case series of 574 adults reported an upper gastrointestinal bleeding rate of 1.4% (8 of 574 patients).[45] In an endoscopic approach study, bleeding complication rate occurred in 0.2% of patients not on antiplatelet therapy, compared to 2.9% in those receiving antiplatelet agents.[46] A more recent study of 1234 patients found an association between bleeding and low platelet counts, antiplatelet therapy, and heparinization following gastrostomy insertion.[47] However, a large retrospective analysis reported no bleeding events in patients on therapeutic anticoagulation or antiplatelet therapy.[48] Over-the-wire exchanges, or exchanges through mature tracts of these catheters are considered low-risk procedures.

### Biliary Interventions

Due to the proximity of biliary structures to arterial vessels and their intra-organ course through the liver, most de novo biliary procedures are considered high-risk. These include cholecystotomy, percutaneous transhepatic cholangiography (PTC), and biliary drain insertion and stenting. Reported bleeding complication rates for biliary drain insertion range widely from 0.61% to 15.85%, with more recent studies using ultrasound guidance falling at the lower end of this range.[49] Over-the wire exchanges, or through mature track exchanges are considered low-risk.

### Transjugular Intrahepatic Porto-Systemic Shunt (TIPS) Creation

Transjugular intrahepatic portosystemic shunt (TIPS) procedures are considered high-risk due to the potential for breaching the liver capsule and puncturing a large, pressurized portal vein outside of liver parenchyma or a hypertrophied hepatic artery. TIPS revisions, such as angioplasty or stenting of an existing shunt without the formation of a new tract, are considered low-risk procedures.

## Special Note on Lumbar Punctures

### Background

Lumbar puncture is a common procedure performed across a wide range of medical services, both with and without image guidance. Abnormal laboratory values and medications that may impact the risk of bleeding are frequently encountered in patients undergoing this procedure. Lumbar puncture has an exceptionally low risk of spinal hematoma, estimated at 17 in 10 000 procedures[50] and is therefore considered a low-risk procedure for most patients.

Due to the rarity of spinal hematomas, data on neurological outcomes are limited. One comprehensive review of case reports found favorable neurological recovery in 57% of patients, suggesting a risk of approximately 7 per 10 000 for

spinal hematoma with unfavorable neurological outcome.[51] Decisions regarding transfusion of platelets or plasma, or withholding antiplatelet or anticoagulant therapies, must balance the theoretical reduction in bleeding risk against the known risks of transfusion-related complications and thrombotic events from medication interruption.[52] There is no evidence that thrombocytopenia, abnormal coagulation tests, or withholding medications alters the risk of bleeding complications. The risks associated with platelet and plasma transfusion (Appendix B), as well as the potential for serious thrombotic complications from medication interruption, are likely to outweigh any benefit in reducing bleeding risk.

Lumbar CSF drain insertions should be considered separately from lumbar punctures. There is little evidence regarding their safety and complication rates. However, given the usual 14-gauge needle size required, this procedure is best considered high-risk.

### *Observational Studies Regarding Platelet or INR Thresholds*

Numerous large retrospective studies totaling 317 840 lumbar punctures finds no increase in the risk of bleeding or neurological complications in patients with thrombocytopenia, on anti-platelet agents, on anti-coagulants, or with elevated tests of coagulation (Appendix C).

Randomized trials evaluating platelet or plasma transfusion prior to lumbar puncture are lacking, with systematic reviews estimating that over 47 000 participants would be needed to detect a meaningful reduction in major bleeding complications, highlighting the impracticality of such studies and the potential value of large-scale observational data instead.[53,54] Retrospective studies of patients on antiplatelet therapy undergoing lumbar puncture found no increase in complications such as spinal hematoma or neurological deficits, even among those continuing agents like ASA or adenosine diphosphate receptor antagonists.[55,56]

## Special Note on Angiography, Sheaths, and Closure Devices

### *Background*

Most of the literature on the safety of arterial access with sheaths for endovascular arterial procedures originates from cardiology studies conducted over 25 years ago, which may not fully apply to modern practice due to advances like radial access, ultrasound guidance, and improved closure devices. Larger sheath sizes (≥7 Fr) are associated with increased risk of hematoma and pseudoaneurysm formation, but not necessarily major bleeding.[57] Overall bleeding risk remains low,[28] even in anticoagulated patients, based on large cardiology cohort studies.[58-60] Factors that may elevate the risk of a procedure using a 6 Fr sheath include: difficult arterial access in the context of obesity, underlying significant arterial disease at the site of access (which increases the risk of failure of vascular closure device use), and a patient history of significant bleeding following prior procedures.

### *Recommendations*

- Use the 6 to 7 Fr threshold between low- and high-risk as a guiding principle, not an absolute rule
- Consider patient-specific factors that increase risk, including difficult arterial access (eg, obesity), significant arterial disease/stenosis at access site, prior history of bleeding complications
- Procedures with sheaths ≥7 Fr may be performed without interrupting anticoagulation or antiplatelet therapy in select scenarios, including recent coronary stent insertion, mechanical heart valves, planned intraprocedural anticoagulation, favorable anatomy for closure device use. Stroke thrombectomy is commonly performed with sheath sizes of 8 Fr or greater, while the patient is receiving active thrombolytics or already on anticoagulation.
- The final decision on how to proceed should involve shared decision-making between the operator and patient.

## Managing Anticoagulation and Antiplatelet Medications

The following tables provide general guidance on the timing of anticoagulant and antiplatelet therapy around procedures with varying bleeding risk. These recommendations aim to balance the risk of perioperative bleeding with the need to prevent thromboembolic events. Table 3 addresses anticoagulant drugs, while Table 4 covers antiplatelet agents. The details regarding how to transfusion components and coagulation factor replacements (eg, prothrombin complex concentrates and fibrinogen) were considered out of scope and the reader is directed to recently published guidelines.[30,54,61,62]

### *How Should We Manage Anticoagulants Before Urgent (6-24 Hours) or Emergent (<6 Hours) Procedures*

For direct oral anticoagulants (dabigatran, rivaroxaban, apixaban, edoxaban), a DOAC level can be measured if available. DOAC levels refer to anti-factor Xa assays for rivaroxaban, apixaban, and edoxaban, and dilute thrombin time for dabigatran. If the anti-factor Xa level is <50 ng/mL or the dilute thrombin time is <50 seconds, there is likely minimal residual anticoagulant effect; you can proceed with the procedure without considering a reversal agent. If the DOAC level is at or above these cutoffs, or is unknown, consider a reversal agent. Reversal agents for DOACs comprise prothrombin complex concentrates (for apixaban, edoxaban, or rivaroxaban), and idaracizumab (for dabigatran). A guide to reversal agents for DOACs in the setting of bleeding – which also applies to reversal in the setting of urgent or emergent procedures is available from Thrombosis Canada.[63]

**Table 3.** General Guidance on the Periprocedural Management of Anticoagulant Drugs.

| Anticoagulant | Suggested last dose before low-risk procedures (0%-2% major bleed risk at 2 d) | Suggested last dose before high-risk procedures (>2 major bleed risk at 2 d) | Suggested first dose after high-risk procedures (>2% major bleed risk at 2 d) | Other considerations |
|---|---|---|---|---|
| Warfarin | No need to discontinue, unless concerns that patient will have a supratherapeutic INR on day −1 | 5 d | Same day, evening; consider bridging LMWH on day after procedure if patient has high thrombotic risk | If the patient's INR is consistently supratherapeutic, you may elect to check INR on day −1 to ensure it is ≤1.8. Oral vitamin K can be administered if it is not below this level. If you are considering bridging after a procedure, consult the appropriate service (eg, internal medicine, thrombosis medicine, hematology) |
| Dabigatran (Pradaxa®) | No need to discontinue | Evening, 2 d prior. (3 d if eGFR <50 mL/min) | 1 d after | Ensure you have a current eGFR |
| Rivaroxaban (Xarelto®) | No need to discontinue | 2 d | 1 d after | |
| Apixaban (Eliquis®) | No need to discontinue | Evening, 2 d | 1 d after | |
| Edoxaban (Savaysa®) | No need to discontinue | 2 d | 1 d after | |
| Therapeutic dose low molecular weight heparin (LMWH): dalteparin, enoxaparin, tinzaparin | No need to discontinue | 24 h | 1 d after | Starting prophylactic dose LMWH on day +1, prior to restarting therapeutic dose LMWH, is an option for patients with high risk for thromboembolism. If you are considering this strategy, consult the appropriate service (eg, internal medicine, thrombosis medicine, hematology) |
| Prophylactic dose low molecular weight heparin (LMWH): dalteparin, enoxaparin, tinzaparin | No need to discontinue | 12 h | Same day, evening | |
| IV unfractionated heparin (any dose) | No need to discontinue | 4-6 h | 6 h | Some institutions use "low-dose" and "standard-dose" IV unfractionated heparin regimens; periprocedural recommendations are the same for both. When resuming UFH post-operatively in a patient with high risk for bleeding, you may elect to avoid a bolus dose and commence with a similar or lower intensity infusion rate. |
| Subcut unfractionated heparin (prophylactic dose) | No need to discontinue | 8 h | Same day, evening | |
| Fondaparinux (Arixtra®) (therapeutic dose) | No need to discontinue | 2 d (3 d if eGFR <50 mL/min) | 1 d after | Ensure you have a current eGFR |
| Fondaparinux (Arixtra®) (prophylactic dose) | No need to discontinue | 2 d (3 d if eGFR <50 mL/min) | Same day, evening | Ensure you have a current eGFR |
| Bivalirudin | No need to discontinue | 2 h | 4 h | |
| Argatroban | No need to discontinue | 2 h | 4 h | |

**Table 4.** General Guidance on the Periprocedural Management of Antiplatelet Drugs.

| Antiplatelet | Suggested last dose before low-risk procedure (0%-2% major bleed risk at 2 d) | Suggested last dose before non-low-risk procedure (2%-4% major bleed risk at 2 d) | Suggested first dose after non-low-risk procedure (2%-4% major bleed risk at 2 d) |
|---|---|---|---|
| ASA | No need to discontinue | 5 d | Same day, evening |
| Ticagrelor | No need to discontinue | 3 d | Same day, evening |
| Clopidogrel | No need to discontinue | 5 d | Same day, evening |
| Prasugrel | No need to discontinue | 7 d | Same day, evening |
| ASA/dipyridamole (Aggrenox) | No need to discontinue | 3 d | Same day, evening |

If a patient is receiving UFH, and there is insufficient time to stop the drug before a procedure, protamine sulfate can be used to reverse the anticoagulant effect; 1 mg of protamine reverses 100 U of UFH. A practical approach to calculate the amount of heparin to be reversed is to take 100% of the UFH dose given in the previous hour + 50% of the UFH dose given in the hour before + 25% of the UFH dose given in the hour before that; this is an estimate of the amount of UFH to be reversed. The usual initial dose of protamine is 20 to 50 mg by slow IV infusion over 15 to 20 minutes due to the risk of anaphylactoid reactions. Protamine is much less effective for LMWH than for UFH, although it should still be used if necessary.

No reversal agent is currently available in Canada for fondaparinux.

Andexanet alfa is a specific reversal agent that rapidly reverses the anticoagulant activity of all factor Xa inhibitors (UFH, LMWH, fondaparinux, and oral direct factor Xa inhibitors such as rivaroxaban, apixaban, and edoxaban). At this time it has not been approved for public reimbursement in any provincial or territorial jurisdiction in Canada, hence it is not widely available.

### *How Should We Assess Our Patient's Unique Bleeding and Thrombotic Risks?*

The above tables provide general guidance on periprocedural management of anticoagulant and antiplatelet drugs. It is acceptable to deviate from the general guidance provided, based on local practice patterns. This guidance may also be modified depending on a patient's unique bleeding and thrombotic risks.

A patient's perioperative risk for thrombosis involves estimating the risk for arterial thrombotic events (including stroke and systemic embolism for patients with atrial fibrillation or a mechanical heart valve), and the risk for venous thromboembolism (including a history of venous thromboembolism, inherited or acquired thrombophilias, or active cancer).

A patient's perioperative risk for bleeding should consider procedure-related factors, as outlined in the tables above. It should also consider medications, including allopathic medications like aspirin, and non-allopathic and complementary therapies. Risk assessment should also account for a personal or family history of bleeding disorders or excessive bleeding, and comorbidities which may increase bleeding risk (eg, age >65, EtOH use, hypertension, stroke, renal dysfunction, liver dysfunction). Ultimately, the best predictor of whether a patient will bleed with a procedure is whether they have bled with previous procedures.

Patients with an elevated bleeding risk may require a longer hold prior to a procedure, and/or a delayed or modified restart after a procedure. Patients with an elevated thrombosis risk may require "bridging anticoagulation" – a strategy of administering a short acting parenteral anticoagulant while their usual oral anticoagulant is interrupted, to decrease the amount of time that a patient is not covered with anticoagulation. Inferior vena cava (IVC) filters should not be routinely used in the periprocedural setting. IVC filters have shown no reduction in pulmonary embolism (PE) or mortality compared to standard pharmacologic prophylaxis, while filter placement is associated with increased risks such as deep vein thrombosis (DVT), filter-related complications (eg, migration, fracture, thrombosis), and low retrieval rates.[64]

Patients who are felt to have an unusually high bleeding or thrombotic risk should be referred to the appropriate service (eg, internal medicine, thrombosis medicine, hematology) for their advice on periprocedural management.

## Limitations

These recommendations reflect expert consensus in areas where high-quality evidence is limited. Key gaps include the lack of observational studies to quantify bleeding risk for cervical nerve blocks, uncertainty around the safety and classification of peripheral nerve cryo-thermolysis, and insufficient validation of emerging tests such as ROTEM. Further research is needed to strengthen these recommendations, and the Working Group welcomes the opportunity to update and refine this guidance as new evidence becomes available.

## Conclusion

These guidelines are designed to make everyday decisions about patient management more practical for radiologists managing bleeding risk during image-guided procedures. They build on the 2019 SIR recommendations,[4] but adapt them for Canadian practice, adding clarity where evidence was limited and simplifying steps that were challenging to implement. Our aim throughout is straightforward: to help teams prepare patients safely, reduce unnecessary delays, and keep care consistent across departments. Most image-guided procedures are very safe, with a low risk of complications, so in most cases, routine bloodwork or stopping antiplatelet and anticoagulant medications is not needed.

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## Supplemental Material

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## References

1. Douketis JD, Spyropoulos AC. Perioperative management of patients taking direct oral anticoagulants: a review. *JAMA*. 2024;332(10):825-834. doi:10.1001/jama.2024.12708
2. Douketis JD, Spyropoulos AC, Kaatz S, et al. Perioperative bridging anticoagulation in patients with atrial fibrillation. *N Engl J Med*. 2015;373(9):823-833. doi:10.1056/NEJMoa1501035
3. Bannow BTS, Lee A, Khorana AA, et al. Management of cancer-associated thrombosis in patients with thrombocytopenia: guidance from the SSC of the ISTH. *J Thromb Haemost*. 2018;16(6):1246-1249. doi:10.1111/jth.14015
4. Patel IJ, Rahim S, Davidson JC, et al. Society of Interventional Radiology consensus guidelines for the periprocedural management of thrombotic and bleeding risk in patients undergoing percutaneous image-guided interventions—part II: recommendations. *J Vasc Interv Radiol*. 2019;30(8):1168-1184.e1. doi:10.1016/j.jvir.2019.04.017
5. Aljundi L, Chaar A, Boshara P, et al. Incidence of bleeding in patients on different anticoagulants and antiplatelet therapies undergoing thoracentesis. *BMJ Open Respir Res*. 2021;8(1):e000874. doi:10.1136/bmjresp-2021-000874
6. Hibbert RM, Atwell TD, Lekah A, et al. Safety of ultrasound-guided thoracentesis in patients with abnormal preprocedural coagulation parameters. *Chest*. 2013;144(2):456-463. doi:10.1378/chest.12-2374
7. Orlandi E, Citterio C, Seghini P, Di Nunzio C, Mordenti P, Cavanna L. Thoracentesis in advanced cancer patients with severe thrombocytopenia: ultrasound guide improves safety and reduces bleeding risk. *Clin Respir J*. 2018;12(4):1747-1752. doi:10.1111/crj.12739
8. Ault MJ, Rosen BT, Scher J, Feinglass J, Barsuk JH. Thoracentesis outcomes: a 12-year experience. *Thorax*. 2015;70(2):127-132. doi:10.1136/thoraxjnl-2014-206114
9. Cantey EP, Walter JM, Corbridge T, Barsuk JH. Complications of thoracentesis: incidence, risk factors, and strategies for prevention. *Curr Opin Pulm Med*. 2016;22(4):378-385. doi:10.1097/MCP.0000000000000285
10. Rowley MW, Agarwal S, Seetharam AB, Hirsch KS. Real-time ultrasound-guided paracentesis by radiologists: near zero risk of hemorrhage without correction of coagulopathy. *J Vasc Interv Radiol*. 2019;30(2):259-264. doi:10.1016/j.jvir.2018.11.001
11. Pache I, Bilodeau M. Severe haemorrhage following abdominal paracentesis for ascites in patients with liver disease. *Aliment Pharmacol Ther*. 2005;21(5):525-529. doi:10.1111/j.1365-2036.2005.02387.x
12. Grabau CM, Crago SF, Hoff LK, et al. Performance standards for therapeutic abdominal paracentesis. *Hepatology*. 2004;40(2):484-488. doi:10.1002/hep.20317
13. LoDuca TP, Nemr C, Gegios AR, et al. Managing bleeding risks and complications of imaging-guided breast biopsy: a primer for radiologists. *Radiographics*. 2026;46(1):e250117. doi:10.1148/rg.250117
14. Loving VA, Johnston BS, Reddy DH, et al. Antithrombotic therapy and hematoma risk during image-guided core-needle breast biopsy. *Radiology*. 2023;306(1):79-86. doi:10.1148/radiol.220548
15. Lewis JD, Groszkiewicz A, Hefelfinger L, et al. Clinically significant bleeding complications of percutaneous breast biopsy: 10-year analysis and a proposed management algorithm. *Clin Imaging*. 2023;104:110017. doi:10.1016/j.clinimag.2023.110017
16. Bain BJ. Bone marrow biopsy morbidity and mortality. *Br J Haematol*. 2003;121(6):949-951. doi:10.1046/j.1365-2141.2003.04329.x
17. Liu B, Limback J, Kendall M, et al. Safety of CT-guided bone marrow biopsy in thrombocytopenic patients: a retrospective review. *J Vasc Interv Radiol*. 2017;28(12):1727-1731. doi:10.1016/j.jvir.2017.08.009
18. Stensby JD, Long JR, Hillen TJ, Jennings JW. Safety of bone marrow aspiration and biopsy in severely thrombocytopenic patients. *Skeletal Radiol*. 2021;50(5):915-920. doi:10.1007/s00256-020-03623-5
19. Hobbs C, Howles S, Derry F, Reynard J. Suprapubic catheterisation: a study of 1000 elective procedures. *BJU Int*. 2022;129(6):760-767. doi:10.1111/bju.15727
20. Ahmed I, Gertner E. Safety of arthrocentesis and joint injection in patients receiving anticoagulation at therapeutic levels. *Am J Med*. 2012;125(3):265-269. doi:10.1016/j.amjmed.2011.08.022
21. Chelly JE. Risk of bleeding associated with the combination of thromboprophylaxis and peripheral nerve blocks: role of the technique. *Reg Anesth Pain Med*. 2015;40(4):396-397. doi:10.1097/AAP.0000000000000214
22. Mehta SD, Weber K, Fleisher L, et al. Assessing the need for preprocedural laboratory tests and stopping non-steroidal anti-inflammatory drugs/aspirin in patients undergoing percutaneous bone and soft tissue biopsies. *Cardiovasc Intervent Radiol*. 2019;42(11):1588-1596. doi:10.1007/s00270-019-02274-x
23. Stecker MS, Johnson MS, Ying J, et al. Time to hemostasis after traction removal of tunneled cuffed central venous catheters. *J Vasc Interv Radiol*. 2007;18(10):1232-1239; quiz 1240. doi:10.1016/j.jvir.2007.06.035
24. Silberzweig JE, Sacks D, Khorsandi AS, Bakal CW; Society of Interventional Radiology Technology Assessment Committee. Reporting standards for central venous access. *J Vasc Interv Radiol*. 2003;14(9 Pt 2):S443-S452. doi:10.1097/01.rvi.0000094617.61428.bc
25. Beathard GA, Urbanes A, Litchfield T. The risk of bleeding with tunneled dialysis catheter placement. *J Vasc Access*. 2016;17(5):397-400. doi:10.5301/jva.5000586

26. Tercan F, Ozkan U, Oguzkurt L. US-guided placement of central vein catheters in patients with disorders of hemostasis. *Eur J Radiol*. 2008;65(2):253-256. doi:10.1016/j.ejrad.2007.04.002
27. Potet J, Arnaud FX, Thome A, et al. Peripherally inserted central catheter placement in patients with coagulation disorders: a retrospective analysis. *Diagn Interv Imaging*. 2015;96(11):1147-1151. doi:10.1016/j.diii.2014.12.012
28. Potet J, Thome A, Curis E, et al. Peripherally inserted central catheter placement in cancer patients with profound thrombocytopaenia: a prospective analysis. *Eur Radiol*. 2013;23(7):2042-2048. doi:10.1007/s00330-013-2778-1
29. van Baarle FLF, Tisheh A, Jhingoeriesingh SS, Vlaar APJ, Biemond BJ. Contribution of coagulopathy on the risk of bleeding after central venous catheter placement in critically ill thrombocytopenic patients. *Crit Care Explor*. 2022;4(1):e0621. doi:10.1097/CCE.0000000000000621
30. Metcalf RA, Nahirniak S, Guyatt G, et al. Platelet transfusion: 2025 AABB and ICTMG international clinical practice guidelines. *JAMA*. 2025;334(7):606-617. doi:10.1001/jama.2025.7529
31. Monahan H, Schmit G, Atwell T, Schmitz J, Gunderson T, Greene E. Risk factors associated with significant bleeding events after ultrasound-guided percutaneous native renal biopsies: a review of 2204 cases. *Abdom Radiol*. 2019;44(6):2316-2322. doi:10.1007/s00261-019-01962-z
32. Relvas M, Gonçalves J, Castro I, Diniz H, Mendonça L, Coentrão L. Effects of aspirin on kidney biopsy bleeding complications: a systematic review and meta-analysis (PROSPERO 2021 CRD42021261005). *Kidney360*. 2023;4(5):700-710. doi:10.34067/KID.0000000000000091
33. Boyum JH, Atwell TD, Schmit GD, et al. Incidence and risk factors for adverse events related to image-guided liver biopsy. *Mayo Clin Proc*. 2016;91(3):329-335. doi:10.1016/j.mayocp.2015.11.015
34. Seeff LB, Everson GT, Morgan TR, et al. Complication rate of percutaneous liver biopsies among persons with advanced chronic liver disease in the HALT-C trial. *Clin Gastroenterol Hepatol*. 2010;8(10):877-883. doi:10.1016/j.cgh.2010.03.025
35. DesRoche C, Callum J, Scholey A, et al. Platelet and INR thresholds and bleeding risk in ultrasound guided percutaneous liver biopsy: a before-after implementation of the 2019 Society of Interventional Radiology Guidelines Observational Quality Improvement Study. *Can Assoc Radiol J*. 2024;75(4):931-938. doi:10.1177/08465371241252059
36. Heerink WJ, de Bock GH, de Jonge GJ, Groen HJM, Vliegenthart R, Oudkerk M. Complication rates of CT-guided transthoracic lung biopsy: meta-analysis. *Eur Radiol*. 2017;27(1):138-148. doi:10.1007/s00330-016-4357-8
37. Facciorusso A, Abd El Aziz MA, Tartaglia N, et al. Microwave ablation versus radiofrequency ablation for treatment of hepatocellular carcinoma: a meta-analysis of randomized controlled trials. *Cancers*. 2020;12(12):3796. doi:10.3390/cancers12123796
38. Zhao F, Zhang T, Yang Q, Zhang X, Yang F, Qian N. Safety of local thermal ablation in hepatocellular carcinoma patients with cirrhosis and severe thrombocytopenia. *Sci Rep*. 2024;14(1):28350. doi:10.1038/s41598-024-79416-w
39. Harisinghani MG, Gervais DA, Maher MM, et al. Transgluteal approach for percutaneous drainage of deep pelvic abscesses: 154 cases. *Radiology*. 2003;228(3):701-705. doi:10.1148/radiol.2283020924
40. Michalopoulos GD, Yolcu YU, Ghaith AK, Alvi MA, Carr CM, Bydon M. Diagnostic yield, accuracy, and complication rate of CT-guided biopsy for spinal lesions: a systematic review and meta-analysis. *J Neurointerv Surg*. 2021;13(9):841-847. doi:10.1136/neurintsurg-2021-017419
41. Radecka E, Brehmer M, Holmgren K, Magnusson A. Complications associated with percutaneous nephrolithotripsy: supra- versus subcostal access. A retrospective study. *Acta Radiol*. 2003;44(4):447-451. doi:10.1080/j.1600-0455.2003.00083.x
42. Egilmez H, Oztoprak I, Atalar M, et al. The place of computed tomography as a guidance modality in percutaneous nephrostomy: analysis of a 10-year single-center experience. *Acta Radiol*. 2007;48(7):806-813. doi:10.1080/02841850701416528
43. Rana AM, Zaidi Z, El-Khalid S. Single-center review of fluoroscopy-guided percutaneous nephrostomy performed by urologic surgeons. *J Endourol*. 2007;21(7):688-691. doi:10.1089/end.2006.0281
44. Agrawal-Patel S, Brar H, Elia M, et al. Is it safe to continue aspirin in patients undergoing percutaneous nephrolithotomy? *Urology*. 2024;183:32-38. doi:10.1016/j.urology.2023.09.022
45. Seo N, Shin JH, Ko GY, et al. Incidence and management of bleeding complications following percutaneous radiologic gastrostomy. *Korean J Radiol*. 2012;13(2):174-181. doi:10.3348/kjr.2012.13.2.174
46. Parlar YE, Mustafayev F, Vahabov C, et al. Risk of bleeding after percutaneous endoscopic gastrostomy in patients using antithrombotic drugs. *Surg Laparosc Endosc Percutan Tech*. 2023;33(5):540-542. doi:10.1097/SLE.0000000000001210
47. Ota K, Takeuchi T, Masuda D, et al. Risk factors for postoperative bleeding and early death in percutaneous endoscopic gastrostomy: a multicenter retrospective study. *J Gastroenterol Hepatol*. 2022;37(1):97-103. doi:10.1111/jgh.15680
48. Thosani N, Rashtak S, Kannadath BS, et al. Bleeding risk and mortality associated with uninterrupted antithrombotic therapy during percutaneous endoscopic gastrostomy tube placement. *Am J Gastroenterol*. 2021;116:1868-1875. doi:10.14309/ajg.0000000000001348
49. Lee YT, Yen KC, Liang PC, Wu CH. Procedure-related risk factors for bleeding after percutaneous transhepatic biliary drainage: a systematic review and meta-analysis. *J Formos Med Assoc*. 2022;121(9):1680-1688. doi:10.1016/j.jfma.2021.11.013
50. Bodilsen J, Mariager T, Vestergaard HH, et al. Association of lumbar puncture with spinal hematoma in patients with and without coagulopathy. *JAMA*. 2020;324(14):1419-1428. doi:10.1001/jama.2020.14895
51. Brown MW, Yilmaz TS, Kasper EM. Iatrogenic spinal hematoma as a complication of lumbar puncture: what is the risk and best management plan? *Surg Neurol Int*. 2016;7(Suppl 22):S581-S589. doi:10.4103/2152-7806.189441
52. Smith CC, Schneider B, McCormick ZL, et al. Risks and benefits of ceasing or continuing anticoagulant medication for image-guided procedures for spine pain: a systematic review. *Pain Med*. 2018;19(3):438-448. doi:10.1093/pm/pnx152
53. Estcourt LJ, Malouf R, Hopewell S, Doree C, Van Veen J. Use of platelet transfusions prior to lumbar punctures or epidural anaesthesia for the prevention of complications in people with thrombocytopenia. Cochrane Haematological Malignancies Group, ed. *Cochrane Database Syst Rev*. 2018;4(4):CD011980. doi:10.1002/14651858.CD011980.pub3
54. Estcourt LJ, Birchall J, Allard S, et al. Guidelines for the use of platelet transfusions. *Br J Haematol*. 2017;176(3):365-394. doi:10.1111/bjh.14423

55. Nash M, Bloch S, Golan D. Safety of lumbar puncture for people who are treated with ADP receptor antagonists. *J Neurol*. 2023;270(6):3052-3057. doi:10.1007/s00415-023-11628-y
56. Stichaller L, Krajnc N, Leutmezer F, et al. Antiplatelet therapy is not associated with increased risk of complications after lumbar puncture. *J Neurol*. 2025;272(1):88. doi:10.1007/s00415-024-12864-6
57. Levin SR, Farber A, Bertges DJ, et al. Larger sheath size for infrainguinal endovascular intervention is associated with minor but not major morbidity or mortality. *Ann Vasc Surg*. 2019;60:327-334. doi:10.1016/j.avsg.2019.04.003
58. Cantor WJ, Mahaffey KW, Huang Z, et al. Bleeding complications in patients with acute coronary syndrome undergoing early invasive management can be reduced with radial access, smaller sheath sizes, and timely sheath removal. *Catheter Cardiovasc Interv*. 2007;69(1):73-83. doi:10.1002/ccd.20897
59. Di Biase L, Burkhardt JD, Santangeli P, et al. Periprocedural stroke and bleeding complications in patients undergoing catheter ablation of atrial fibrillation with different anticoagulation management: results from the Role of Coumadin in Preventing Thromboembolism in Atrial Fibrillation (AF) Patients Undergoing Catheter Ablation (COMPARE) randomized trial. *Circulation*. 2014;129(25):2638-2644. doi:10.1161/CIRCULATIONAHA.113.006426
60. Birnie DH, Healey JS, Wells GA, et al. Pacemaker or defibrillator surgery without interruption of anticoagulation. *N Engl J Med*. 2013;368(22):2084-2093. doi:10.1056/NEJMoa1302946
61. National Advisory Committee on Blood and Blood Products (NAC). Guidelines & Recommendations. Accessed January 22, 2026. https://nacblood.ca/en/guidelines-recommendations
62. Green L, Bolton-Maggs P, Beattie C, et al. British Society of Haematology Guidelines on the spectrum of fresh frozen plasma and cryoprecipitate products: their handling and use in various patient groups in the absence of major bleeding. *Br J Haematol*. 2018;181(1):54-67. doi:10.1111/bjh.15167
63. Thrombosis Canada. DOACs: management of bleeding. 2024. Accessed October 14, 2025. https://thrombosiscanada.ca/clinical_guides/pdfs/MANAGEMENTOFBLEEDINGINPATIENTS_80.pdf
64. Kaufman JA, Barnes GD, Chaer RA, et al. Society of Interventional Radiology clinical practice guideline for inferior vena cava filters in the treatment of patients with venous thromboembolic disease. *J Vasc Interv Radiol*. 2020;31(10):1529-1544. doi:10.1016/j.jvir.2020.06.014
65. European Association for the Study of the Liver. EASL Clinical Practice Guidelines on prevention and management of bleeding and thrombosis in patients with cirrhosis. *J Hepatol*. 2022;76(5):1151-1184. doi:10.1016/j.jhep.2021.09.003
66. Kovalic AJ, Majeed CN, Samji NS, Thuluvath PJ, Satapathy SK. Systematic review with meta-analysis: abnormalities in the international normalised ratio do not correlate with periprocedural bleeding events among patients with cirrhosis. *Aliment Pharmacol Ther*. 2020;52(8):1298-1310. doi:10.1111/apt.16078
67. Intagliata NM, Rahimi RS, Higuera-de-la-Tijera F, et al. Procedural-related bleeding in hospitalized patients with liver disease (PROC-BLeeD): an international, prospective, multicenter observational study. *Gastroenterology*. 2023;165(3):717-732. doi:10.1053/j.gastro.2023.05.046
68. Lisman T, Bernal W. Management of hemostatic disorders in patients with advanced liver disease admitted to an intensive care unit. *Transfus Med Rev*. 2017;31(4):245-251. doi:10.1016/j.tmrv.2017.06.002
69. Drolz A, Horvatits T, Roedl K, et al. Coagulation parameters and major bleeding in critically ill patients with cirrhosis. *Hepatology*. 2016;64(2):556-568. doi:10.1002/hep.28628
70. Callum JL. *Bloody Easy. 5.1: Blood Transfusions, Blood Alternatives and Transfusion Reactions: A Guide to Transfusion Medicine*. 5th ed. ORBCoN, Ontario Regional Blood Coordinating Network; 2023.
71. Jackman RP, Deng X, Bolgiano D, et al. Leukoreduction and ultraviolet treatment reduce both the magnitude and the duration of the HLA antibody response. *Transfusion*. 2014;54(3):672-680. doi:10.1111/trf.12317
72. Moncharmont P, Barday G, Meyer F. Red blood cell alloimmunisation after platelet transfusion: a 5-year study. *Blood Transfus*. 2014;12 Suppl 1(Suppl 1):s147-s148. doi:10.2450/2013.0099-13
73. Cohn CS. Platelet transfusion refractoriness: how do I diagnose and manage? *Hematology Am Soc Hematol Educ Program*. 2020;2020(1):527-532. doi:10.1182/hematology.2020000137
74. Mair B, Benson K. Evaluation of changes in hemoglobin levels associated with ABO-incompatible plasma in apheresis platelets. *Transfusion*. 1998;38(1):51-55. doi:10.1046/j.1537-2995.1998.38198141498.x
75. Kozak M, Hallan DR, Stoltzfus M, Rizk E. Lumbar puncture in thrombocytopenia: the floor is not firm. *Cureus*. 2023;15(7):e42019. doi:10.7759/cureus.42019
76. Howard SC, Gajjar A, Ribeiro RC, et al. Safety of lumbar puncture for children with acute lymphoblastic leukemia and thrombocytopenia. *JAMA*. 2000;284(17):2222-2224.
77. Chung HH, Morjaria S, Frame J, et al. Rethinking the need for a platelet transfusion threshold of $50 \times 10^9$ /L for lumbar puncture in cancer patients. *Transfusion*. 2020;60(10):2243-2249. doi:10.1111/trf.15988
78. Jordan A, Jain AG, Koipallil GK, et al. Can we lower the platelet threshold of $\geq 50 \times 10^9$/L for performing a lumbar puncture safely in patients with hematological malignancies? *Ann Hematol*. 2023;102(3):663-668. doi:10.1007/s00277-022-05073-6
79. Ning S, Kerbel B, Callum J, Lin Y. Safety of lumbar punctures in patients with thrombocytopenia. *Vox Sang*. 2016;110(4):393-400. doi:10.1111/vox.12381
80. Portuguese AJ, Rothberg A, Gorgone M, Strawderman M, Jacob C. Safety of bedside lumbar puncture in adult patients with thrombocytopenia. *Ann Hematol*. 2020;99(8):1755-1762. doi:10.1007/s00277-020-04148-6
81. Vavricka SR, Walter RB, Irani S, Halter J, Schanz U. Safety of lumbar puncture for adults with acute leukemia and restrictive prophylactic platelet transfusion. *Ann Hematol*. 2003;82(9):570-573. doi:10.1007/s00277-003-0707-0
82. Öztürk E. Retrospective evaluation of lumbar puncture and intrathecal chemotherapy in thrombocytopenic patients. *Transfus Apher Sci*. 2021;60(2):103023. doi:10.1016/j.transci.2020.103023
83. Van Veen JJ, Vora AJ, Welch JC. Lumbar puncture in thrombocytopenic children. *Br J Haematol*. 2004;127(2):233-234. doi:10.1111/j.1365-2141.2004.05178.x
84. Habib U, Buch K, Mehan WA. Lowering platelet threshold to 20,000/μL for fluoroscopy-guided lumbar puncture does not result in observed clinical adverse outcomes. *J Comput Assist Tomogr*. 2024;48(6):951-954.

## Appendix A

### Managing Chronic Liver Disease

*Coagulation Testing and Hemostatic Correction With Transfusion in Patients With Cirrhosis Undergoing Interventional Radiology Procedures.* Patients with cirrhosis frequently undergo procedures in interventional radiology, such as transjugular intrahepatic portosystemic shunt (TIPS), liver biopsy, paracentesis, transarterial embolizations, and tumor ablation. These patients often have concurrent derangements in platelet counts and laboratory tests of hemostasis – platelet count, international normalized ratio (INR), and fibrinogen level. To complicate the management further, the INR has not been shown to predict bleeding.[65-67] In addition, there is a paucity of studies demonstrating a link between thrombocytopenia and hypofibrinogenemia (except at extreme levels <0.6 g/L).[66]

*Concerns Regarding Conventional Coagulation Testing.* INR, while traditionally used to assess bleeding risk across a broad range of patients, is not a reliable predictor of peri-procedure bleeding in patients with cirrhosis,[66,67] as it reflects only procoagulant factor deficiency and not the concurrent reduction in anticoagulant proteins such as protein C and anti-thrombin.[68] Platelet counts are often reduced due to hypersplenism and decreased liver synthesis of thrombopoietin, but do not necessarily correlate with bleeding due to concurrent increases in other coagulation proteins (eg, von Willebrand).[68] Fibrinogen, an acute-phase reactant, may be preserved until late stages of disease, but observational studies suggest levels <0.6 g/L may be associated with increased bleeding risk.[69]

## Appendix B

### Risks of Platelet and Plasma Transfusions in Canada

| Risks of platelet transfusion[70] | Risk estimate |
|---|---|
| Anti-HLA antibodies (impact on transplant eligibility) | 28% risk with leukoreduced platelet transfusions[71] |
| Anti-RBC antibodies (Risk of Hemolytic Disease of the Fetus and Newborn (HDFN)) | 1.3% risk[72] |
| Anti-platelet antibodies (Risk of platelet refractoriness, Fetal-neonatal alloimmune thrombocytopenia (FNAIT)) | 2%-8% risk[73] |
| Bacterial sepsis | Theoretical (all platelets pathogen reduced) |
| Viral transmission | All known viral agents <1 in 1 million risk |
| Transfusion associated circulatory overload (TACO) | 1 in 100 |
| Serious allergic reaction | 1 in 40 000 |
| Minor allergic reaction | 1 in 100 |
| Transfusion-related acute lung injury (TRALI) | 1 in 10 000 |
| Post-transfusion purpura | 1 in 100 000 |
| Acute hemolytic transfusion reaction | <1 in 9000 (risk mitigated by pooling and use of platelet additive solution)[74] |
| Febrile non-hemolytic transfusion reaction | 1 in 200 |
| Transfusion-related graft vs host disease (TA-GvHD) | Theoretical (all platelets pathogen reduced) |
| **Risks of plasma transfusion** | **Risk estimate** |
| Transfusion-associated circulatory overload (TACO) | 1 in 100 |
| Transfusion-related acute lung injury (TRALI) | 1 in 10 000 |
| Serious allergic reaction | 1 in 40 000 |
| Minor allergic reaction | 1 in 100 |

# Appendix C

*Retrospective Observational Studies Evaluating Lumbar Punctures With and Without Laboratory Abnormalities*

| Year/country | No. of procedures | No. with low platelets | No. with no platelet count | No. with high INR | Findings |
|---|---|---|---|---|---|
| 2023/USA Kozak[75] | 224 512 | 2920 (≤50) | – | – | No difference in the rate of bleeding between patients with and without a platelet count of 50 or less (and no difference in rates of paralysis or need for spinal decompression) |
| 2020/Denmark Bodilsen[50] | 83 711 | 7875 (≤150) | 23 814 (28%) | 1393 (INR ≥1.5) | Spinal hematoma rate at 30 d were not different between patients with and without abnormal laboratory tests; spinal hematoma rate was 0.17% |
| 2000/USA Howard[76] | 5223 | 941 (≤50) | 208 (4%) | – | No serious neurological complications observed. |
| 2020/USA Chung[77] | 2259 | 110 (≤50) | – | 369 on therapeutic anticoagulation | No spinal hematomas observed. |
| 2023/USA Jordan[78] | 900 | 218 (≤50) | – | Median INR 1.0-1.1 | No spinal hematomas observed. |
| 2016/Canada Ning[79] | 369 | 28 (≤50) | – | – | No spinal hematomas observed. |
| 2020/USA Portuguese[80] | 262 | 78 (<150) | 1 (0.4%) | 18 (>1.4) | No spinal hematomas observed. 51 patients were on anti-platelet agents. |
| 2003/Switzerland Vavricka[81] | 195 | 118 (≤100) | – | – | No spinal hematomas observed. |
| 2020/Turkey Öztürk[82] | 152 | 18 (<50) | – | – | No spinal hematomas observed. |
| 2004/UK Van Veen[83] | 129 | 129 (<50) | – | – | No spinal hematomas observed. |
| 2024/USA Habib[84] | 128 | 46 (≤50) | – | Median INR 1.2 in both groups | No spinal hematomas observed. |
| Total | 317 840 | 12 481 | 24 023 | – | No studies observed higher rates of bleeding complications or neurological complications. |

# Periprocedural Management of Patient Bleeding

## Classification of Procedure Risk

Past bleeding is the most important predictor of bleeding risk. A prior significant bleeding event is a significant enough factor in decision-making that it should override any other recommendations.

| Low-Risk | High-Risk |
|---|---|
| • Breast procedures (ablations, biopsies including vacuum-assisted and large-gauge, drainage insertions, localizations)<br>• Catheter exchanges (gastrostomy, biliary, nephrostomy, nephroureterostomy, ureteric stents, abscess drains, gastrostomy/gastrojejunostomy including conversions, etc)<br>• Chest tube placement for pleural effusion (tunneled and non-tunneled)<br>• Diagnostic arteriography and arterial interventions, sheath size 6 Fr or less, all radial access<br>• Diagnostic venography and venous interventions<br>• Dialysis access interventions (fistulograms, fistula declotting, angioplasty and stenting)<br>• Facet joint injections and medial branch nerve blocks (thoracic and lumbar spine)<br>• IVC filter placement and removal<br>• Lumbar puncture<br>• MSK injections (joints, tendons, and muscles)<br>• Nerve blocks (sacral lateral branch blocks, hypogastric, celiac plexus)<br>• Paracentesis<br>• Peritoneal drains (tunneled / non-tunneled)<br>• Superficial abscess drainage or biopsy (palpable lesion, lymph node, soft tissue, thyroid, superficial bone - extremities and bone marrow aspiration)<br>• Superficial MSK ablations<br>• Suprapubic catheter insertion<br>• Thoracentesis<br>• Transjugular liver biopsy<br>• Tunneled venous catheter placement / removal (including ports)<br>• Venous access and removal (PICC, Hickman, ports, tunneled and non-tunneled dialysis line insertion) | • Ablations (liver, renal, lung)<br>• Advanced thoracic venous intervention (SVC recanalization)<br>• Arterial procedures (sheath size 7 Fr or greater)<br>• Biliary procedures (PTC, biliary drain, cholecystostomy)<br>• Cervical blocks and epidural injections<br>• Deep fluid/abscess drainage<br>• Feeding catheter insertions (gastrostomy, gastrojejunostomy, direct jejunostomy)<br>• Lung biopsy, lung nodule coil localization<br>• Lumbar CSF drain insertion<br>• Nephrostomy<br>• Solid deep organ biopsy (such as liver, renal, prostate), deep lymph node / soft tissue biopsy (retroperitoneal, pelvic, mediastinal)<br>• Transjugular intrahepatic porto-systemic shunt (TIPS) / direct portal vein access<br>• Venous and pulmonary artery thrombectomy*<br>• Vertebroplasty / kyphoplasty |

*These patients are almost always fully anticoagulated; do not interrupt anticoagulation prior to the procedure. Follow the **ISTH guidelines** for platelet thresholds in patients with thrombocytopenia.

# Periprocedural Management of Patient Bleeding

## Laboratory Testing Recommendations

| Procedure | Normal Liver Function | Chronic Liver Disease |
|---|---|---|
| Low-Risk | Platelet and INR: do not screen.<br>However, if bloodwork has already been performed:<br>INR: correct to within range of 2.0–3.0<br>Platelet: transfuse if < 20 × $10^9$/ L | Platelet and INR: do not screen.<br>However, if bloodwork has already been performed:<br>INR: N/A<br>Platelet: transfuse if < 20 × $10^9$/ L |
| High-Risk | Routinely screen platelet and INR<br>INR: correct to < 1.8<br>Platelets: transfuse if < 50 × $10^9$/ L | Routinely screen platelet and INR<br>INR: correct to < 2.5<br>Platelet: transfuse if < 30 × $10^9$/ L |

*Laboratory tests are considered valid if within 12 weeks for a stable outpatient and within 72 hours for an inpatient.*

## Drug Management

This table combines anticoagulant and antiplatelet guidance for periprocedural management.
Low-risk procedures: generally, do not discontinue listed drugs.
High-risk procedures: follow timing for last dose and restart as shown below.

| **Anticoagulant Drugs** | | | |
|---|---|---|---|
| **Agent** | **Low-risk Procedures: Discontinue drugs?** | **Last Dose Before High-Risk Procedures** | **First Dose After High-Risk Procedures** |
| Warfarin | No (check INR) | 5 days | Same day, evening |
| Dabigatran (Pradaxa®) | No | 2 days<br>(3 days if eGFR<50) | 1 day after |
| Rivaroxaban (Xarelto®) | No | 2 days | 1 day after |
| Apixaban (Eliquis®) | No | 2 days | 1 day after |
| Edoxaban (Savaysa®) | No | Evening of 2 days prior | 1 day after |
| Therapeutic dose LMWH Dalteparin/Enoxaparin/ Tinzaparin | No | 24 hours | 1 day after |
| Prophylactic dose LMWH Dalteparin/Enoxaparin/ Tinzaparin | No | 12 hours | Same day, evening |
| IV unfractionated heparin (any dose) | No | 4–6 hours | 6 hours |
| **Antiplatelet Drugs** | | | |
| ASA | No | 5 days | Same day, evening |
| Clopidogrel | No | 5 days | Same day, evening |
| Ticagrelor | No | 3 days | Same day, evening |
| Prasugrel | No | 7 days | Same day, evening |

These guidelines are intended to cover most scenarios in a radiology department but should not be considered absolute rules. They do not replace individualized clinical judgment. Each patient's circumstances are unique, and radiologists must apply their professional judgment while considering local policies and available resources.

# Gestion du risque hémorragique périprocédural

## Classification du risque associé aux procédures

Les antécédents de saignement constituent le facteur prédictif le plus important du risque hémorragique. Un événement hémorragique significatif antérieur représente un facteur si déterminant dans la prise de décision qu'il doit avoir préséance sur toute autre recommandation.

| Risque faible | Risque élevé |
|---|---|
| • Procédures mammaires (ablations, biopsies incluant celles de gros calibre assistées par aspiration sous vide, mise en place de drains, localisations)<br>• Échanges de cathéter (biliaire, néphrostomie, néphro-urétérostomie, cathéter double J, drainage d'abcès, gastrostomie/gastro-jéjunostomie incluant la conversion, etc.)<br>• Mise en place d'un drain thoracique pour épanchement pleural (avec ou sans tunnelisation)<br>• Artériographie diagnostique et thérapeutique, introducteur de diamètre de 6 Fr ou moins, tout accès radial<br>• Veinographie diagnostique et thérapeutique<br>• Interventions pour accès vasculaire de dialyse (fistulogramme, thrombectomie de fistule, angioplastie et mise en place d'une endoprothèse)<br>• Infiltrations facettaires et blocs nerveux de branches médiales (rachis thoracique et lombaire)<br>• Mise en place et retrait d'un filtre sur la veine cave inférieure<br>• Ponction lombaire<br>• Injections musculosquelettiques (articulations, tendons et muscles)<br>• Blocs nerveux (branches latérales sacrées, hypogastrique, plexus cœliaque)<br>• Paracentèse<br>• Drains péritonéaux (avec ou sans tunnelisation)<br>• Drainage ou biopsie d'abcès superficiel (lésion palpable, ganglion lymphatique, tissu mou, thyroïde, os superficiel)<br>• Ablations musculosquelettiques superficielles<br>• Mise en place d'une sonde sus-pubienne<br>• Thoracocentèse<br>• Biopsie hépatique transjugulaire<br>• Mise en place et retrait d'accès veineux tunnelisés ou non (incluant les dispositifs d'accès vasculaire implantable (Port-a-Cath), PICC, Hickman, cathéters d'hémodialyse) | • Ablations (hépatique, rénale, pulmonaire)<br>• Interventions veineuses thoraciques avancées (telles les recanalisations de la veine cave supérieure)<br>• Procédures artérielles (introducteur de 7 Fr et plus)<br>• Procédures biliaires (cholangiographie transhépatique percutanée, drain biliaire, cholécystostomie)<br>• Blocs nerveux cervicaux et injections épidurales<br>• Drainage de liquide/abcès profond<br>• Mise en place de tubes d'alimentation (gastrostomie, gastro-jéjunostomie, jéjunostomie directe)<br>• Biopsie pulmonaire, marquage de localisation d'un nodule pulmonaire<br>• Mise en place d'un drain lombaire pour LCR<br>• Néphrostomie<br>• Biopsie d'un organe plein profond (foie, rein, prostate), biopsie d'un ganglion lymphatique/ de tissu mou profond (rétropéritonéal, pelvien, médiastinal)<br>• Shunts porto-systémiques intrahépatiques transjugulaires (TIPS)/accès directs à la veine porte (portographie)<br>• Thrombectomie* d'une artère ou veine pulmonaire<br>• Vertébroplastie/cyphoplastie |

*Ces patients sont presque toujours sous anticoagulation thérapeutique. Ne pas interrompre le traitement anticoagulant avant la procédure. Suivre les **lignes directrices de l'ISTH** pour revoir les seuils de plaquettes chez les patients atteints de thrombocytopénie.

# Gestion du risque hémorragique périprocédural

## Recommandations pour la gestion du risque hémorragique périprocédural

| Procédure | Fonction hépatique normale | Maladie hépatique chronique |
|---|---|---|
| Risque faible | Plaquettes et INR : Aucun dosage systématique n'est requis.<br>Toutefois, si des tests sanguins ont été déjà effectués :<br>INR : corriger pour se situer dans la plage 2,0 - 3,0<br>Plaquettes : transfuser si < 20 × $10^9$/L | Plaquettes et INR : Aucun dosage systématique n'est requis.<br>Toutefois, si des tests sanguins ont été déjà effectués :<br>INR : S.O.<br>Plaquettes : transfuser si < 20 × $10^9$/L |
| Risque élevé | Doser les plaquettes et l'INR de manière systématique<br>INR : corriger pour se situer < 1,8<br>Plaquettes : transfuser si < 50 × $10^9$/L | Doser les plaquettes et l'INR de manière systématique<br>INR : corriger pour être < 2,5<br>Plaquettes : transfuser si < 30 × $10^9$/L |

*Les examens de laboratoire sont considérés comme valides s'ils ont été effectués dans les 12 semaines précédentes pour un patient externe stable et dans les 72 heures pour un patient hospitalisé.*

## Tableau de gestion des médicaments en contexte périprocédural

Ce tableau combine un guide pour la gestion des anticoagulants et des antiplaquettaires dans le contexte périprocédural.
Procédures à risque faible : habituellement, ne pas interrompre les médicaments énumérés.
Procédures à risque élevé : tenir compte du moment de la dernière administration et reprendre tel qu'indiqué ci-dessous.

| **Médicaments anticoagulants** | | | |
|---|---|---|---|
| **Agent** | **Procédure à risque faible : Interruption du médicament requise?** | **Dernière administration avant la procédure à risque élevé :** | **Reprise après la procédure à risque élevé :** |
| Warfarin | Non (vérifier l'INR) | 5 jours | Le soir, même jour |
| Dabigatran (Pradaxa®) | Non | 2 jours<br>(3 jours si DFGe < 50) | 1 jour après |
| Rivaroxaban (Xarelto®) | Non | 2 jours | 1 jour après |
| Apixaban (Eliquis®) | Non | 2 jours | 1 jour après |
| Edoxaban (Savaysa®) | Non | Soir, 2 jours | 1 jour après |
| HFPM à dose thérapeutique daltéparine/enoxaparine/tinzaparine | Non | Interrompre pendant 24 h | 1 jour après |
| HFPM à dose prophylactique daltéparine/enoxaparine/tinzaparine | Non | Interrompre pendant 12 h | Le soir, même jour |
| Héparine IV, non fractionnée (quelle que soit la dose) | Non | Interrompre 4 à 6 h | Reprendre après 6 h |
| **Médicaments antiplaquettaires** | | | |
| ASA | Non | 5 jours | Le soir, même jour |
| Clopidogrel | Non | 5 jours | Le soir, même jour |
| Ticagrelor | Non | 3 jours | Le soir, même jour |
| Prasugrel | Non | 7 jours | Le soir, même jour |

Ces lignes directrices sont conçues pour couvrir la plupart des scénarios rencontrés dans un service de radiologie, mais elles ne doivent pas être considérées comme des règles absolues. Elles ne remplacent pas le jugement clinique de chaque praticien ou praticienne. Le cas de chaque patient est unique et les radiologistes doivent faire preuve d'un jugement professionnel en tenant compte des politiques locales et des ressources disponibles.