



INTRA-ARTERIAL INJECTION

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INTRODUCTION

Inadvertent intra-arterial injection can result in various complications, which can result from direct vessel trauma or be related to inadvertent injection of a substance into the arterial blood supply [1-3]. Needle-induced trauma may cause arterial vasospasm. Both arterial dissection and vasospasm can result in brain or spinal cord stroke [4-6]. Intra-arterial injection of an anesthetic can result in seizure or temporary paralysis [7]. Intravenous injections of an anesthetic may also cause seizures in patients with an existing history of epilepsy, even at subtoxic dosages [8]. Inadvertent intra-arterial injection of particulate steroid, most commonly encountered during transforaminal injection, can result in embolic infarct of the spinal cord or brain [1-3]. The **IPSI Technical Manual** provides detailed coverage of the risks associated with intra-arterial injection [9]. Additional coverage of local anesthetic systemic toxicity (LAST) related to the intravascular (intravenous/intra-arterial) injection of local anesthetic is provided in a **separate emergency protocol**.

TYPICAL PRESENTATION

Case #1: Woman with neck pain (Adapted from Karasek and Bogduk 2004 [10])

A 55-year-old woman who previously benefited from a cervical transforaminal epidural steroid injection (CTFESI) presented for a CTFESI at the right C6-7 level under fluoroscopic guidance. Using an oblique view, the spinal needle entered the intervertebral foramen. The fluoroscope was then rotated to the AP view, and the needle was advanced to half the width of the articular pillar but not beyond the uncinus line. Iohexol was injected under real-time fluoroscopic imaging without digital subtraction, and the intervertebral foramen filled appropriately without vascular uptake. A test dose of 1 ml of 2% lidocaine was injected. Following the local anesthetic test dose, real-time imaging during contrast medium administration showed no arterial uptake but demonstrated filling of the contralateral epidural and vertebral veins. Over the next 30 minutes, the following occurred:

- About 1 minute after the test bolus was administered, the patient reported feeling unwell to the physician.
- The physician immediately terminated the procedure.
- About 2-3 minutes later, the patient reported subjective weakness of all four extremities.
- The physician immediately performed a neurological exam, revealing paralysis of both upper and lower extremities with absent sensation to pinprick but preserved proprioception in all extremities.

Case #2: Woman with “hip” pain (Adapted from Kennedy et al. 2009 [11])

An 83-year-old woman presented with a sudden onset of left “hip” pain, and a lumbar MRI demonstrated a left L3-4 foraminal disc extrusion compressing the exiting L3 nerve. After several months of treatments, including physical therapy and oral medications, she underwent a left L3-4 transforaminal epidural steroid injection (TFESI) with 2 weeks of relief. The decision was made to perform a second left L3-4 TFESI. During the second TFESI procedure, after supraneural needle placement, Isovue-300 was injected under real-time fluoroscopic imaging, and no arterial or venous uptake or intrathecal spread was observed. Digital subtraction imaging was not performed. A mixture of 1 ml of bupivacaine 0.75% and 1 ml of Celestone Soluspan (6mg/ml) was injected. After the injection of local anesthetic and steroid, the following occurred:

- Upon needle withdrawal, the patient reported acute bilateral lower extremity numbness and weakness.
- A neurological examination was performed, demonstrating paralysis of both lower extremities with loss of sensation to pinprick.

DIAGNOSIS

Case #1: Woman with neck pain

This case of intra-arterial injection was suggestive of combined epidural and radicular artery injection during the local anesthetic test dose. Because the local anesthetic was injected into the radicular artery, which perfused the anterior spinal artery (ASA), anesthesia of the spinal cord’s anterior and anterolateral quadrants with sparing of the posterior columns resulted. This injection of a radicular artery was not visible under real-time imaging during contrast medium administration, but it may have been visible had digital subtraction imaging been available and utilized. While contralateral venous uptake was observed during contrast medium injection, intravenous local anesthetic injection alone would not have caused the presenting symptoms and signs in the ASA distribution. Intraneural injection would similarly not have caused such bilateral, symmetric symptoms in the ASA distribution. Imaging was not suggestive of intrathecal injection, and intrathecal injection would not spare the posterior columns and may have cardiopulmonary effects. The procedure was appropriately terminated; injection of particulate steroids likely would have resulted in a spinal cord embolic infarct and permanent deficits.

Case #2: Woman with “hip” pain

This case of intra-arterial injection was suggestive of combined epidural and radicular artery injection of a particulate steroid into the artery of Adamkiewicz (arteria radicularis magna), which perfuses the lower anterior spinal cord, resulting in an acute spinal cord infarction. The artery arises from a thoracic or lumbar spinal artery; in 69-85% of cases, on the left. It enters via an intervertebral foramen, where it travels in proximity to a spinal nerve and can be inadvertently accessed even in a correctly performed TFESI. Particulate steroids can cause an embolus or red blood cell agglutination, and multiple guidelines have discouraged the routine use of particulate steroids for TFESIs [9,12].

EMERGENCY PROTOCOL

1. Immediately stop the procedure. If the patient is awake, alert, and conversant, ask about symptoms, including an appropriate review of systems, and perform a neurological examination. If there is no apnea and no concern for stroke of the brain or spinal cord, monitor the patient and prepare for discharge.
2. If apnea occurs in the office setting, one team member should call EMS (911 or local equivalent) and explain the nature of the emergency; if in a hospital setting, call for a rapid response or code team. Meanwhile, other team members should initiate Basic Life Support (BLS) and Advanced Cardiovascular Life Support (ACLS) as indicated.
3. If a stroke of the brain or spinal cord is suspected (e.g., if a particulate steroid was injected), in the office setting, call EMS to initiate a Stroke Code at the nearest stroke center, and in the hospital setting, initiate a Stroke Code.
4. Team members should maintain a patent airway, administer high-flow oxygen if desaturation is noted, and obtain IV access. Meanwhile, one team member should document the last known well time and perform a neurological examination or NIH Stroke Scale, if possible [13].
5. Transport to the Emergency Department in care of emergency medical technicians (EMTs) as a Stroke Code to expedite obtaining an MRI and immediate neurological and possibly neurosurgical care.
6. Notify the patient's emergency contact or family.
7. Consider debriefing the team and reviewing procedures to prevent future occurrences.

RISK MITIGATION/PREVENTION

Use of non-particulate steroids

- Particulate steroids can create an embolus with intra-arterial injection, which can result in catastrophic brain or spinal cord strokes. Particulate steroids should never be used for cervical and thoracic TFESI, and several guidelines recommend that they should only be used for lumbar TFESI under unique circumstances (namely, having failed treatment with non-particulate steroids). Physicians should consider precautions, including infraneural approach, digital subtraction imaging when available, and possibly a local anesthetic test dose, in accordance with the *IPSIS Technical Manual* [9].

Use of a test dose of local anesthetic in selected situations

- Case #1 demonstrates that administering a local anesthetic test dose before a particulate steroid injection during lumbar TFESI may help prevent an intra-arterial injection.
- However, physicians should be aware of the significant limitations of local anesthetic test doses. The sensitivity of the local anesthetic test dose has not been established. A false-negative test dose followed by the intra-arterial injection of a particulate steroid would certainly prove disastrous [7]. During lumbar TFESIs, the test dose may create a false sense of security as the needle may move into a radiculomedullary artery between the time (1.5 minutes) that the local anesthetic and particulate steroids are injected. Furthermore, during cervical TFESIs, there is a risk of seizure if the local anesthetic is injected inadvertently into the vertebral artery [12,14].

Use of real-time fluoroscopy with contrast medium injection to identify intra-arterial injection

- Fluoroscopy using real-time contrast medium injection through microbore tubing is required. It is superior to aspiration alone for identifying unintentional vascular access, including intra-arterial injection [15-18].

Use of digital subtraction imaging in select situations may enhance the ability to recognize intra-arterial injection

- Digital subtraction imaging, when available, may increase the likelihood of recognizing intra-arterial injection of contrast medium before injection of local anesthetic and/or steroids [15-19].

Aborting procedure upon recognition of intra-arterial injection

- If intra-arterial injection is observed or suspected, the physician should abort the procedure and consider attempting it again at a later date [9].

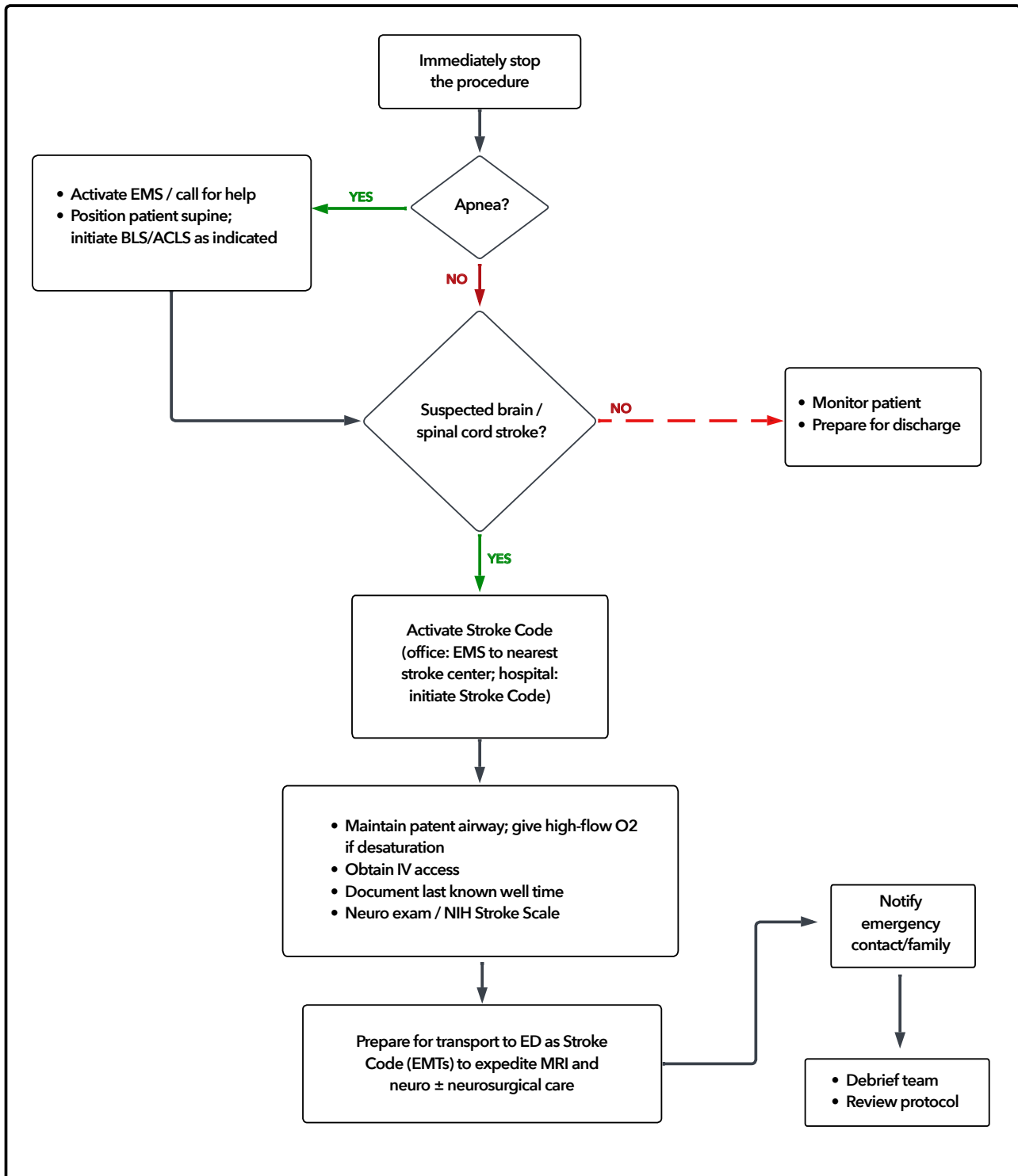
Advance Preparation for Emergencies

- Regardless of the service site, the facility should be appropriately equipped to manage emergencies (see **Advance Preparation for Emergencies** [20]).

KEY CONSIDERATIONS/TAKEAWAYS

- Medical society statements recommend ONLY non-particulate dexamethasone for cervical and thoracic TFESIs and against the routine use of particulate steroids for LTFESI – recommendations that may also be applied to other injections with a high risk of intra-arterial injection, such as lateral atlanto-axial joint injections [9,12]. The use of particulate steroids for cervical and thoracic TFESI is contraindicated. If dexamethasone proves ineffective in lumbar TFESIs, particulate steroids may be used as a secondary agent, in which case additional safety measures should be considered [9].
- Neurological symptoms or signs suggestive of intra-arterial injection should alert the physician to initiate appropriate next steps immediately.

SUSPECTED INTRA-ARTERIAL INJECTION



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DISCLAIMER

While these Emergency Protocols are intended to identify elements critical to the management of emergencies during interventional pain procedures, they are not intended to be inclusive of all proper emergency management protocols or exclusive of other methods of care reasonably utilized to obtain the same results. Nothing contained in these documents is intended to be used as a substitute for the care and knowledge of the individual clinician. They are guidelines based on evidence-informed expert consensus. IPSIS makes no representation and assumes no responsibility for the accuracy of the information contained or available through this website, and such information is subject to change without notice. Given the individual patient's clinical circumstances and preferences, the clinician's independent medical judgment should always determine patient care and treatment. Practitioners are advised to consider management options in the context of their training, background, and institutional capabilities when selecting recommended treatment options. IPSIS is not responsible, nor does it assume any legal liability or responsibility for the accuracy, completeness, clinical efficacy, or value of any such information or apparatus, product, or process described or referenced through this website or the information contained therein.