Strategies to Minimize Risk in Lumbar Transforaminal Injections: Imaging and Injectate

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Myth #1: Neither the use of digital subtraction technology nor live fluoroscopy is needed during the performance of lumbar transforaminal epidural steroid injections.

Fact: Use of live fluoroscopy and/or digital subtraction technology are recommended when performing lumbar transforaminal epidural steroid injections.

An intra-arterial injection during lumbar transforaminal epidural steroid injection (TFESI) poses the potential for serious neurologic complications. The risk is mitigated by the use of non-particulate, preservative-free steroids. While there is one report describing spinal cord infarction after TFESI with dexamethasone, the complete lack of transparency and absence of procedural images prevents drawing any conclusions concerning the causality of the event [1,2]. In order to minimize the potential for an inadvertent vascular injection during lumbar TFESI, a test dose of contrast medium is recommended before any other agent is injected [3]. Digital subtraction imaging (DSI) has been found to increase the detection of intravascular uptake of contrast compared to live fluoroscopy alone [4,5], but DSI may not be readily available and does increase radiation exposure to both patients and providers [6]. Real time fluoroscopy has been shown to be superior to aspiration tests and static fluoroscopic images [7]. In light of the available evidence, real time fluoroscopy and/or DSI with injection of contrast medium through extension tubing using an antero-posterior (AP) view is recommended by the Multisociety Pain Workgroup (MPW) during lumbar TFESI before the injection of any substance that could be potentially hazardous to the patient [8].

Myth #2: Particulate steroids can be used as a first-line treatment in lumbar TFESIs.

Fact: Non-particulate steroids (e.g. preservative-free dexamethasone) should be used as a first-line agent for lumbar TFESI.

In all cases of severe neurologic complications associated with lumbar TFESI, particulate steroids have been included in the epidural injectate, with only one potential exception [1,2,8]. Ex-vivo studies have shown that all steroid preparations other than dexamethasone contain particles and form aggregates which can act as emboli if injected intra-arterially and are of adequate size to block small terminal arterioles. Dexamethasone, a non-particulate steroid, does not form particles or aggregates [9,10,11]. Animal studies demonstrate that particulate steroids injected directly into arteries (internal carotid artery or vertebral artery) can cause serious neurological injury; however, no neurological injury was observed when dexamethasone was injected into the same arteries [12,13]. While the published literature is mixed [14,15], there is strong evidence indicating that TFESI with dexamethasone is not inferior to TFESI with particulate steroid for the treatment of lumbar radicular pain [16,17]. Given the substantially improved safety profile of dexamethasone, this agent is recommended for first-line use in lumbar TFESI [8].
Myth #3: A local anesthetic test dose does not affect the safety of lumbar TFESI.

Fact: The use of an anesthetic test dose for lumbar TFESI is controversial, especially when the epidural injectate contains preservative-free dexamethasone rather than particulate corticosteroid.

The rationale for using an anesthetic test dose prior to injection of steroid during TFESI was introduced when particulate steroid, rather than dexamethasone, was primarily being used in the epidural injectate. In theory, inadvertent intra-arterial injection of local anesthetic would cause temporary lower extremity weakness that warns the physician of unintended needle tip position prior to injection of a particulate steroid that, if injected into this artery, may cause neurologic infarction. However, given the evidence for the safety of dexamethasone use in TFESI, the use of an anesthetic test dose is likely unnecessary. In fact, a test dose of local anesthetic could cause temporary motor block, which might increase the possibility of a fall post-injection, thus decreasing the overall safety of this procedure. If particulate steroid is injected, the potential benefit of the test dose may outweigh the risks associated with these side effects.

Myth #4: The use of digital subtraction imaging during lumbar TFESI correctly identifies intra-arterial uptake and allows prevention of neurological events in all cases.

Fact: The proper implementation and interpretation of digital subtraction imaging is operator dependent and does not inherently prevent an intra-arterial injection during lumbar transforaminal epidural steroid injection.

A case of spinal cord infarction with resulting paraplegia has been reported in association with a lumbar TFESI in which DSI was used [18]. This case report illustrates that use of DSI does not guarantee safety, as the correct implementation and interpretation of DSI images depends on operator skills and experience. The appropriate use of DSI includes the following steps:

1. Instruct the patient to hold their breath, not speak, and remain still during the several second DSI run.
2. Obtain a blank mask image (i.e. no observable bony projections).
3. Inject contrast and observe the flow pattern in a wide AP view.
4. Inject an adequate volume of contrast medium to provide confidence of epidural spread without concomitant fill of a radiculomedullary artery or other blood vessels.

It must be acknowledged that there is insufficient published evidence to determine if intra-arterial injection can be ruled out by DSI in every case even when these technical factors are optimized by an operator who is also experienced in the interpretation of the images acquired. As such, it remains important to use dexamethasone as the first line agent for lumbar TFESIs, even when live DSI is used.
References


