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Particulates vs. Non-Particulates: Steroid Choice for Lumbar Transforaminal Injections FactFinder

Committed to providing helpful information to our members about key patient safety issues, the International Spine Intervention Society's Patient Safety Committee has developed a FactFinder series. FactFinders will explore and debunk myths surrounding patient safety issues. The intent of this FactFinder is to address issues surrounding use of particulates in lumbar transforaminal epidural steroid injections.

Myth: There is strong evidence that non-particulate steroids are less effective than particulate steroid formulations for lumbar transforaminal injections.

Fact: Studies have demonstrated the efficacy of non-particulate corticosteroids for lumbar radicular pain. In comparing non-particulate and particulate steroids, particulate corticosteroids have a less favorable risk profile, but past studies had demonstrated non-statistically significant superiority over non-particulate steroids in the short-term treatment of lumbar radicular pain.[1] Newer studies, however, have failed to substantiate this difference over a longer follow-up period.[2,3] Practitioners must continue to weigh the risks and benefits of each steroid formulation, with due consideration to the anatomical region, technique, and individual patient response.

Transforaminal epidural injections are considered more effective than interlaminar and caudal approaches for lumbar radicular pain, but are also associated with an increased risk of ischemic neurologic injury.[4-6] The mechanism of injury is felt to be inadvertent intra-arterial injection of particulate corticosteroid resulting in embolic spinal cord ischemia and paraplegia. All particulate corticosteroid preparations (*i.e.*, triamcinolone, betamethasone acetate, and methylprednisolone) have been implicated in published case reports of paraplegia. Light microscopy studies have demonstrated that the particles in these steroid preparations are either larger than red blood cells (RBC) or form aggregates larger than red blood cells.[7] Additionally, animal studies have shown CNS infarction with intra-arterial injection of particulate steroids. On the other hand, dexamethasone, with particles smaller than RBCs on microscopic evaluation, has not been associated with any reports of paraplegia, and has not created neurologic complications in animal studies.

In light of this rare but extremely serious neurological complication, some have advocated for the exclusive use of non-particulate corticosteroids with all transforaminal injections. Others argue that particulate corticosteroids may have better efficacy than non-particulate formulations and therefore should continue to be utilized. This belief is based on the published literature thus far:

> Kim *et al.* found non-particulate dexamethasone phosphate comparable to particulate methylprednisolone acetate in effectiveness in the treatment of lumbar radiculopathy.[8] The study also noted that dexamethasone had a "non-statistically

significant trend toward less pain relief and shorter duration of action" of non-particulate corticosteroids.[8] A 2010 study by Park *et al.* showed a statistically significant difference in the visual analog score between patients treated with dexamethasone and those given triamcinolone, favoring the triamcinolone group; however the two groups did not differ significantly on the McGill Pain Questionnaire or the Oswestry Disability Index after treatment.[9]

Two studies were presented at the 2013 International Spine Intervention Society's Annual Scientific Meeting which also compared effectiveness of particulate versus non-particulate steroids used in lumbar transforaminal injections. Kennedy *et al.* presented results from a randomized, double-blind, multi-center, prospective study comparing the efficacy of dexamethasone and triamcinolone.[2] While there were no statistically significant differences in pain relief or surgical rates between particulate and non-particulate steroids, a significant difference was found in the total number of injections needed with the dexamethasone group requiring more injections than the triamcinolone group. El-Yahchouchi *et al.* presented results of a retrospective observational study which found no evidence that dexamethasone is less effective than particulate steroids in lumbar transforaminal steroid injections performed for radicular pain with or without radiculopathy.[3] Another prospective, randomized controlled trial is currently underway comparing dexamethasone and Depo-Medrol in lumbar transforaminal injections.[10]

Given the efficacy and safety data of non-particulate corticosteroids, combined with anatomic considerations, many practitioners are opting to utilize only non-particulate corticosteroids for transforaminal epidural steroid injections at or above the level of the L3 spinal nerve. Others are using dexamethasone as a first line medication for lumbar transforaminal injections. However, until the literature is significantly more robust, the International Spine Intervention Society believes that physicians should continue to make the risk-benefit calculation for each patient, including utilizing particulate corticosteroid preparations when appropriate.

If physicians choose to use particulate corticosteroids, they should consider other measures to decrease the risk of paraplegia. As a standard of care, all fluoroscopically-guided transforaminal epidural steroid injections should use real-time fluoroscopic analysis of the injected contrast material to detect arterial flow.[11] Other options that may further reduce the risk of paraplegia include: 1) using digital subtraction technology; 2) injecting a test dose of local anesthetic; and/or 3) using an infra-neural approach. However, it should be noted that the mere use of a particular technique is not sufficient to prevent injury, as evidenced by a case report of paraplegia despite the use of an anesthetic test dose and digital subtraction technology.[12] In the end, the technique can only supplement the expertise of the physician, not replace it.

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