Diagnostic and Interventional Imaging (2018) xxx, xxx—xxx

RECOMMENDATIONS / *Musculoskeletal imaging*

Société d'imagerie musculosquelettique (SIMS), Fédération de radiologie interventionnelle (FRI), and Société Francophone de radiologie (SFR) recommendations for epidural and transforaminal corticosteroid injections

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KEYWORDS
Pain management;
Spinal interventional procedure;
Corticosteroid;
Steroid;
Epidural injection;
Transforaminal injection

Spinal injections of corticosteroids are routinely used in the treatment of lumbar and cervical radicular pain. These infiltrations are carried out at all spinal levels, essentially transforaminal, interlaminar, and through the facet joint or the sacrococcygeal hiatus. The purpose of these infiltrations is to eliminate inflammation (if present) involved in the pathogenesis of pain and to reduce or eliminate pain in the short term. The medium and long-term efficacy of these infiltrations is, however, difficult to assess given the frequent spontaneous partial or complete pain relief when nerve entrapment is due to a disc herniation.

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https://doi.org/10.1016/j.diii.2018.01.012

Please cite this article in press as: Cotten A, et al. Société d'imagerie musculosquelettique (SIMS), Fédération de radiologie interventionnelle (FRI), and Société Francophone de radiologie (SFR) recommendations for epidural and transforaminal corticosteroid injections. Diagnostic and Interventional Imaging (2018), https://doi.org/10.1016/j.diii.2018.01.012

The growing number of spinal infiltrations in the last 20 years [1] has been accompanied by the publication of articles and meta-analyses, which sometimes contain contradictory results regarding the therapeutic effects obtained. Comparisons between the different studies remain difficult due to disparities in symptoms (back pain versus radicular pain, duration of symptoms before infiltration), diagnosis (degenerative spinal stenoses versus disc herniations), spinal levels (cervical, thoracic or lumbar), injection types (interlaminar versus transforaminal), procedural techniques (blind versus fluoroscopic or CT-guided), type/dose/amount of corticosteroid and/or anesthetic injected, etc. [2,3]. It is also notable that only a small number of good-quality randomized controlled studies have been completed, and even these often have insufficient methodologies (e.g. small samples, variable control groups, different pre- and post-procedure evaluation methodologies, topography of the disk herniation).

The best evidence for an issue can be found in the safety announcement released by the United States FDA in 2014, which stated that epidural corticosteroid injections had not demonstrated their effectiveness and safety, and that corticosteroids were therefore not approved for such use [4]. Several professional societies and experts proceeded to criticize the methodology used by the FDA (e.g., no analysis of the spine location or route of administration, and different population types) [5–7]. Corticoid infiltrations carried out since the announcement has been done off-label [8].

Complications

The considerable growth in the number of spinal infiltrations worldwide has been accompanied by the publication of 40 cases of serious neurological complications (cerebral trunk or cerebellar infarctus, quadriplegia, paraplegia, death). The actual frequency of these complications is difficult to determine since some cases have not been published [9]. However, even if complication rates are higher than reported, their frequency is extremely low given the number of injections performed per year. AFSSAPS, the French health products safety agency (Agence française de sécurité sanitaire des produits de santé) reported 7 neurological complications out of one million spinal injections in 2009 [10]. This complication rate should be compared against the number of complications occurring with non-steroidal anti-inflammatory drugs administered orally (0.2–1.35% myocardial infarctions, 0.09–2.5% ulcers/gastric perforation), 0.13–0.29% cerebrovascular accidents) [11,12].

Injection site

Apart from direct trauma lesions (particularly spinal), epidural hematomas, and septic complications, serious neurological complications have been, in most cases, reported following cervical or lumbar transforaminal infiltrations. For most cases, this can be explained by an accidental arterial catheterization leading to vascular occlusion in the anterior spinal artery or vertebral artery area [9,13–15]. The rare cases of complications at the interlaminar injection site [15–18] have occurred in patients with previous spine surgery, probably because the epidural scar tissue is highly vascularized (neoangiogenesis) and may be connected to a radiculomedullary artery [19]. Single cases of paraplegia and cauda equina syndrome were also noted following an infiltration at the site of the sacrococcygial hiatus [20,21]. Each injection site has its advantages and disadvantages, but transforaminal infiltration remains the preferred site for many teams because it allows delivery of the corticosteroid directly to the inflamed nerve root and may allow a smaller quantity of drug to be administered [22,23]. In a paper published in *Radiology* in 2016 [3], transforaminal injection was considered the preferred site in young patients with acute or subacute radiculopathies and in older patients with chronic unilateral radiculopathies, if imaging correlates with clinical symptoms (with the exception of nerve compression by a facet cyst). However, interlaminar infiltration is recommended in older patients with chronic radiculopathy (frequent multilevel spondylosis) because it allows the corticosteroids to spread cranially and caudally over multiple disk levels [3].

Table 1 Two types of corticosteroids used in the spine.

Particulate corticosteroids (suspensions)	Non-particulate corticosteroids (solutions)
Triamcinolone acetonide (Kenalog, Bristol-Myers Squibb)	Dexamethasone sodium phosphate (Dexamethasone Mylan)
Methylprednisolone acetate (Depomedrol, Pfizer)	Dexamethasone sodium phosphate (Decadron phosphate, Merck)
Prednisolone acetate (Hydrocortancyl, Sanofi-Aventis)	
Betamethasone sodium phosphate + betamethasone acetate (Celestone-Soluspan, Schering-Plough, Kenilworth, NJ)	
Betamethasone dipropionate/Betamethasone disodium phosphate/benzyl alcohol (Diprostene, MSD)	
Cortivazol (Altim, Sanofi Aventis, Paris, France)	

Types of corticosteroids in use

Two types of corticosteroids are or were used in the spine [3,24] (Table 1):

- particulate corticosteroids, suspensions containing corticosteroid esters that are insoluble in iodinated contrast, local anesthetic, and saline material [3]. They include

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