Fluoroscopy-guided spine injections: establishing a successful service in your radiology department or practice

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Image-guided spine injections are a critical component of pain management for patients with neck/back pain and spine-related symptoms such as sciatica. Fluoroscopy-guided spine interventions, such as facet joint steroid injections and epidural steroid injections (ESI) including both the transforaminal and interlaminar approaches, allow for targeted delivery of corticosteroid and anesthetic. As such, ESI and facet joint injections represent an important alternative or bridge to surgery as well as a potential substitute for oral pain medications in patients suffering from spine-related neck or back pain.

In recent years, the number of image-guided spine interventions performed in the USA has increased dramatically [1, 2]. While the majority of spine interventions are performed by anesthesiologists and physiatrists, a small percentage of cases are performed by radiologists [1]. Advantages of radiologists include expertise with multi-modality imaging of the spine and skill at extrapolating three-dimensional anatomy from two-dimensional fluoroscopic images [2]. Challenges that radiologists face in establishing a successful spine injection service, however, include patient recruitment, obtaining consistent physician referrals, and navigating post-injection follow-up clinical care.

At our institution, we began offering radiologist-performed fluoroscopy-guided spine injections in the outpatient setting approximately 5 years ago. While initial volume of cases was low, we were able to increase our numbers over time, averaging 38 injections per month in the 2017 fiscal year and 53 injections per month in the 2018 fiscal year. We currently perform approximately 61 spine injections per month, including lumbar and cervical ESI and facet joint injections. With the increasing financial revenue over time (Fig. 1), we were

able to expand our service to include 2 fixed fluoroscopy c-arm units (also utilized for joint injections), 4 musculoskeletal subspecialized radiologists who perform spine injections (approximately 10% time for each physician), and a dedicated nurse for the spine service (with no other responsibilities). In our experience, a successful spine injection service can be established by radiologists through strategic networking, optimization of patient care, and standardization of policies.

Recruitment

Team members

It is critical to identify radiologists with training in fluoroscopy-guided spine injections and to appoint a lead radiologist to direct the new service. Regular “spine” meetings with participating radiologists to discuss and establish unified policies and practices are important. For radiologists with limited or no training in fluoroscopy-guided spine injections, participating in a dedicated course such as those offered by the Spine Intervention Society can be extremely helpful. Continued attendance at spine-related sessions at national meetings such as RSNA and ASSR is also important to stay up-to-date on current recommendations.

It is useful to identify technologists who have experience with or can be trained in spine injection fluoroscopy. Compared with joint injections, spine injections often require a greater degree of c-arm manipulation. Technologists with a robust understanding of spine anatomy and familiarity with spine injection protocols can greatly increase efficiency of the service. At our institution, we currently have 3 experienced technologists that facilitate spine injections and are currently training a fourth technologist.

In 2017, we were able to hire a full-time spine service nurse given our high volume of spine injections. Responsibilities of the position include consenting patients at the time of injection, screening patients and providing instructions prior to and

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Fig. 1 Financial model. This timeline approach illustration [3] demonstrates the revenue and investments of our fluoroscopy-guided spine injection practice, with time zero on the left and time subsequent going towards the right. Since we already had an established active fluoroscopy-guided joint injection/aspiration practice at time zero, no significant investment was required when fluoroscopy-guided spine injections were initially offered (utilizing the same c-arm, technologists, radiologists, and set of supplies/medications as joint injections). The newly offered spine injections brought in revenue (increasing over time as more and more spine injections were performed), and an investment was made to hire a dedicated spine nurse. The nurse greatly increased the efficiency and popularity of the spine injection practice, leading to more spine injections over time and increasing revenue at an exponential growth rate. Eventually, the rising revenue plateaued (once capacity was reached with time constraints) and a large investment was made to purchase a second c-arm. Subsequently, revenue continued to increase at an exponential rate as efforts were made to recruit more patients and physician referrers

immediately after the injection, and following up with patients by telephone after the injection. All patients are given a direct phone number to contact the nurse with any questions or concerns. Our nurse also interacts regularly with referring clinicians regarding potential “add-on” patients and helps with insurance pre-authorization forms. In our experience, a dedicated spine clinic nurse adds tremendous value to the service.

Physician referrals

We have found that direct communication with potential referring physicians is the best method for patient recruitment. While competing specialties such as PM&R may be understandably reluctant to refer spine injections to radiologists, there are multiple other clinical specialties who routinely see patients with back and neck pain. Given the pre-existing relationship between orthopedic surgeons and musculoskeletal radiologists, marketing a new spine injection service to members of the orthopedic department is a good first step. Advertising the spine injection service with face-to-face radiologist-to-clinician discussion is crucial in establishing a successful physician referral base. At our institution, we have developed robust working relationships with several orthopedic spine surgeons, non-spine orthopedic surgeons, and sports

medicine clinicians who routinely refer patients to us for spine injections. Additionally, we have found that hosting informal “lunch and learn” sessions with the orthopedic department including the physician assistants is helpful in establishing consistent referrals.

Given substantial competition from other physician specialties offering spine injections, creating and maintaining an active physician referral base require radiologists to provide top-notch service. This can be accomplished in several ways. First, radiologists should advertise their expertise in interpreting MRI and hence the ability to review imaging (including imaging performed at outside hospitals) prior to any procedure in order to determine the appropriate level of injection. In our experience, spine surgeons may have a preference to self-determine the level of injection whereas non-spine surgeon clinicians appreciate radiologist selection of the level of injection. We request that all patients have an MRI made available for our review prior to any spine injection. Second, timeliness in scheduling patients and offering same day add-on injections is crucial. Patients who are referred for spine injections often have debilitating back pain and are eager to schedule their injection as soon as possible. Radiologists who can schedule patients sooner than competing specialties will be more successful in establishing a prosperous spine service. And lastly, streamlining repeat injections goes a long way in keeping referring physicians happy. Many patients who undergo spine injections require a follow-up second injection to completely mitigate their pain, either at the same level or at a different level from the first injection. At our institution, spine injections are generally ordered in sets of two so that we can perform a repeat injection as necessary without troubling our referring physicians for another order.

Optimizing patient care

Optimizing patient care is crucial for a successful spine injection service, both for patient satisfaction and to maintain a consistent physician referral base. Documentation of patient pain scores within the electronic medical record helps guide management decisions and adds value for a spine injection service. We obtain a numerical pain score (on a scale of 0 through 10) immediately before and after every spine injection. In addition, our nurse follows up with all patients by telephone to assess symptoms at approximately 2 days and 1 week after the injection, with documentation within the electronic medical record. If symptoms persist at the 1-week follow-up, a 2-week follow-up phone call is performed at which time a repeat injection may be considered.

All patients are provided with written discharge instructions at the time of the injection, including what to expect after the procedure, restrictions, and when to call the radiology team or seek immediate medical care. All patients are provided with a phone number to call (which is monitored by our nurse during working hours) with questions and concerns. In

our experience, offering a direct line of communication with a provider significantly improves patient satisfaction.

In complicated or unusual cases (such as large calcified fibroids overlapping the region of interest), the risks of fluoroscopy-guided spine intervention may outweigh the benefits and computed tomography (CT) guidance may be more appropriate. Referring such patients for CT guided intervention is another method by which radiologists can optimize patient care.

Regulations

Epidural injection of steroid is currently not FDA approved and is considered “off-label”. Off-label medication administration is a common part of medical practice, and as such, this specific detail is not routinely discussed with patients at our institution unless at the patient’s request. Given the risks associated with epidural injections including that of serious neurologic events, the utmost safety standards and precautions must be strictly upheld.

Medication choice

Corticosteroids for ESI can be categorized as particulate or non-particulate based on size [4]. This distinction has gained much scrutiny over the past two decades as ESI complications have been more extensively studied and publicized to the patient population. All known reports of permanent neurologic complications in the literature related to ESI have been associated with the use of particulate steroids and are likely to occur due to inadvertent intravascular injection of steroid. Dexamethasone, a non-particulate steroid, has not been associated with any presumed embolic events to date [4].

In terms of efficacy, there has been conflicting data in the literature regarding the use of particulate versus non-particulate steroids for ESI [4–7]. A recent survey of spine interventionalists demonstrated considerable variability with respect to choice of steroid for transforaminal ESI, underscoring the significant difference of opinion and level of comfort that still exists regarding utilization of these agents [8].

With these considerations in mind, our group has decided to follow the more conservative recommendations of the Spine Intervention Society (SIS). SIS strongly advises against the use of particulate steroids for use in cervical transforaminal ESI, but states particulate steroids may be used for lumbar transforaminal ESI, albeit with increased risk [9]. SIS and others conclude particulate steroids are safe for interlaminar and caudal injections [9]. Our group has decided that the risk of permanent neurologic deficit outweighs any potential therapeutic benefit from particulate steroids, and therefore, we utilize dexamethasone for all spine injections. Utilizing a single corticosteroid for all spine injections also simplifies the

supply chain, ordering, and storage of medications for the spine clinic.

Literature regarding the appropriate dose of corticosteroid for ESI is extremely limited and inconclusive [4]. Our group utilizes 1.0 cc of 10 mg/mL dexamethasone for all of our spine injections. For bilateral injections or injections at 2 levels, we split the standard 10-mg dose in half for each injection. While there is no conclusive literature regarding this approach, we have anecdotally achieved equivalent success with splitting the dose.

It is important to note that choice of anesthetic mixed with steroid is also imperative [10, 11]. Our group utilizes marcaine in the majority of patients (at the request of one of our orthopedic spine surgeons) but may opt for lidocaine instead of marcaine in patients over the age of 65 due to concern for fall risk in the setting of anesthetic-induced leg weakness and/or numbness.

Anti-coagulation and supplements

Great care should be taken to minimize the potential serious adverse events from bleeding when performing a spine injection. Utilizing proper technique for various injection types is paramount. It is also important to follow strict guidelines regarding anticoagulant usage in patients to minimize the risk of bleeding.

After consulting with other injection practices, our group decided to follow the American Society of Regional Anesthesia and Pain Medicine (ASRA) guidelines regarding anticoagulation usage prior to and after spine injections. Our dedicated nurse obtains a medical history from patients during scheduling to determine whether the patient needs to temporarily suspend any anticoagulation medications. We often consult with the patient’s primary doctor or physician specialist that prescribed the medication to determine if it is safe for the patient to temporarily stop the anticoagulant following the published guidelines. The patient is also given written instructions at discharge about when to resume anticoagulation medications.

The American Society of Regional Anesthesia and Pain Medicine (ASRA) also provides an app that can be used on smart phones for easy reference. We keep a printed version of the guidelines in our clinic (Table 1). We continuously update the guidelines when a change is made by the ASRA. Patients are counseled and provided written information/instructions at discharge regarding what signs and symptoms to be aware of that could indicate bleeding after the injection.

Safety considerations

Additional safety precautions utilized in our clinic include a formal time-out performed by the technologist and radiologist prior to every procedure, the use of facemasks and sterile

Table 1 Northwestern radiology spine injection clinic anticoagulation guidelines. “High” refers to high-risk patients which include old age, history of bleeding tendency, concurrent use of other anticoagulants or antiplatelets, liver cirrhosis, and advanced liver or renal disease. All cervical epidural steroid injections are considered as a high-risk patient. “Low” refers to non-high risk patients

Medication	Hold prior to procedure	Restart after procedure	Comments
Aspirin	*Primary Prophylaxis: 6 days **Secondary Prophylaxis: 4 days (determined individually)	24 h	Shared assessment and risk stratification. Stopping ASA not essential
Ibup/Advil/Motrin	High = 1 day	24 h	
Diclofenac	Low = May continue		
Ketorolac (Toradol)			
Naproxen (Aleve)	High = 4 days	24 h	
Meloxicam	Low = may continue		
Etodolac (Lodine)	High = 2 days	24 h	
Indomethacin (Indocin)	Low = may continue		
Nabumetone (Relafen)	High = 6 days	24 h	
Celebrex	Low = may continue		
Celebrex	May continue	May continue	
Warfarin (coumadin)	5 days/INR day of ≤ 1.2 or less	Minimum 6 h, ideally next day	Must be coordinated with referring MD. May bridge with Lovenox
Pradaxa (dabigatran)	4 days	24 h	Must be coordinated with referring MD
	5–6 days impaired renal function		
Eliquis (apixaban)	3 days or 75 h	24 h	Must be coordinated with referring MD
Xarelto (rivaroxaban)	3 days or 65 h	24 h	Must be coordinated with referring MD
Plavix (clopidogrel)	7 days	Standard dose of 75 mg can be started 12 h.	Must be coordinated with referring MD
	5 days if high risk of thromboembolic events	A loading dose should wait 24 h	
Aggrenox	Primary prophylaxis: 6 days Secondary prophylaxis: shared assessment	24 h	Must be coordinated with referring MD
Effient	7–10 days	24 h	Must be coordinated with referring MD
Ticlid (ticlopidine)	5 days	24 h	Must be coordinated with referring MD
Lovenox injection	24 h	12–24 h	Must be coordinated with referring MD
Dalteparin	24 h	12–24 h	
Pletal (cilostazol)	2 days (48 h)	24 h	Must be coordinated with referring MD
Brilinta (ticagrelor)	5 days	24 h	Must be coordinated with referring MD

*Primary prophylaxis: used to prevent the first occurrence of a cardiovascular event. Aspirin use in the absence of established cardiovascular disease as defined by history, examination, and clinical testing

**Secondary prophylaxis: used to prevent recurrence of disease and is defined as when aspirin is used in the presence of overt cardiovascular disease or conditions conferring particular risk (e.g., diabetes mellitus)

gloves, and confirmation that the patient has a driver or other means of public transportation home. On the back of every patient consent form, our nurse documents pertinent patient information through our self-created “ABCD system” which stands for Allergies, “Blood” or anti-coagulation, “Cut” or history of prior spine surgeries, and Driver. Prior to every procedure, the nurse and radiologist jointly review the ABCD information and determine the level of injection based on clinical history and prior imaging. After every procedure, the patient is observed in a recovery room and the nurse confirms that the patient can safely ambulate prior to discharge. Icepacks, juice, and snacks are stocked in case of a vasovagal reaction, and both the procedure and recovery rooms have tables that can be tilted into Trendelenburg position. For further information regarding safety considerations with ESI, we

recommend review of a 2015 consensus statement from a multidisciplinary working group and 13 specialty national organizations [12].

Conclusion

Fluoroscopy-guided spine interventions are commonly performed and well-reimbursed in the USA. Radiologists have the technical skill and imaging knowledge to accurately perform fluoroscopy-guided spine injections, particularly if subspecialized in musculoskeletal imaging or neuroradiology. The creation of a spine injection service adds new value to a radiology department or practice and also serves to fulfill a need for both referring physicians and patients seeking

optimized care. A successful spine injection service can be established by radiologists through strategic networking, patient care optimization, and standardization of policies.

References

1. Palmer WE. Spinal injections for pain management. *Radiology*. 2016;281(3):669–88.
2. Shim E, Lee JW, Lee E, Ahn JM, Kang Y, Kang HS. Fluorocopy guided epidural injections of the cervical and lumbar spine. *Radiographics*. 2017;37(2):537–61.
3. Lexa FJ, Berlin JW. Financial modeling in medicine: cash flow, basic metrics, the time value of money, discount rates, and internal rate of return. *J Am Coll Radiol*. 2005;2(3):225–31.
4. Schneider B, Varghis N, Kennedy DJ. Ideal corticosteroid choice for epidural steroid injections: a review of safety and efficacy. *Curr Phys Med Rehabil Rep*. 2015;3:151–8.
5. Park CH, Lee SH, Kim BI. Comparison of the effectiveness of lumbar transforaminal epidural injection with particulate and nonparticulate corticosteroids in lumbar radiating pain. *Pain Med*. 2010;11(11):1654–8.
6. Bensler S, Sutter R, Pfirrmann CWA, Peterson CK. Particulate versus non-particulate corticosteroids for transforaminal nerve root blocks: comparison of outcomes in 494 patients with lumbar radiculopathy. *Eur Radiol*. 2018;28(3):946–52.
7. El-Yahchouchi C, Geske JR, Carter RE, Diehn FE, Wald JT, Murthy NS, et al. The noninferiority of the nonparticulate steroid dexamethasone vs. the particulate steroids betamethasone and triamcinolone in lumbar transforaminal epidural steroid injections. *Pain Med*. 2013;14(11):1650–7.
8. Clements N, Vydra D, Cushman DM, Naqpal A, Julia J, Zheng P, et al. Trends in steroid agent and diluent choices for epidural steroid injections: a survey of Spine Intervention Society physicians. *Reg Anesth Pain Med*. 2019. <https://doi.org/10.1136/rapm-2018-100366>.
9. Duszynski B. Spine Intervention Society position statement on best practices for epidural steroid injections in the setting of a preservative-free dexamethasone shortage. *Pain Med*. <https://doi.org/10.1093/pm/pnz063>.
10. Watkins TW, Dupre S, Coucher JR. Ropivacaine and dexamethasone: a potentially dangerous combination for therapeutic pain injections. *J Med Imaging Radiat Oncol*. 2015;59(5):571–7.
11. Hwang H, Park J, Lee WK, et al. Crystallization of local anesthetics when mixed with corticosteroid solutions. *Ann Rehabil Med*. 2016;40(1):21–7.
12. Rathmell JP, Benzon HT, Dreyfuss P, et al. Safeguards to prevent neurologic complications after epidural steroid injections: consensus opinions from a multidisciplinary working group and national organizations. *Anesthesiology*. 2015;122(5):974–84.

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