

Letters to the Editor

Digital Subtraction Angiography is Not the Answer for Safe Epidural Injections

TO THE EDITOR:

We read with great interest the recent publication of El Abd et al (1) regarding the intraarterial detection rates identified during transforaminal epidural steroid injections (TFESI). The authors sought to define the rate of detection of arterial uptake observed by using digital subtraction angiography (DSA) that is missed by traditional safety precautions, including that provided by real-time, live fluoroscopy. They enrolled 150 consecutive patients and performed 222 TFESI at the cervical, lumbar, and sacral levels. Live fluoroscopy with contrast medium detected 46 intravascular flow patterns and DSA identified an additional 5 venograms not identified using live fluoroscopy. Interestingly, all 5 of these vascular injections were venous and were found while performing sacral TFESI. These results are similar to those of a prospective study of vascular flow detection rates in lumbosacral TFESI. Lee et al (2) performed 60 lumbar and 20 S-1 TFESI and found 20 cases of intravascular injection (11 at S-1 and 9 in the lumbar spine) utilizing DSA. Real-time fluoroscopic guidance with contrast medium injection predicted 12 of the 20 instances (60%). These authors did not distinguish between arterial versus venous contrast medium uptake, but concede that “the majority of these vascular injections were venous” with a statistically significant higher injection rate at S-1 (2).

In a retrospective analysis by Mclean et al of 134 patients that underwent 177 cervical TFESI, intravascular injection was detected in 18% using real-time fluoroscopy vs. 32.8% when DSA was used ($P = 0.0471$). Notably, all of the vascular flows identified by both live fluoroscopy and DSA were venous and none were arterial (3).

The results of the Lee et al (2) and El Abd et al (1) studies are consistent with what is known about the rich venous plexus in the sacral epidural space, and are supported by previous data in detecting intravascular injections during lumbo-sacral TFESI. Furman et al (4)

looked at 761 TFESI and concluded that “There was a statistically significant higher rate of intravascular injections (21.3%) noted with transforaminal ESIs performed at S-1 ($n = 178$), compared with those at the lumbar levels (8.1%, $n = 583$).”

These studies suggest that while DSA may detect unintentional venous injection at a higher rate than does live fluoroscopy, there is less robust evidence (case reports) that DSA enhances recognition of arterial injection and thus may not be useful for preventing the most catastrophic adverse events associated with TFESI.

We agree with these authors that DSA is not a panacea for preventing adverse outcomes during the performance of neuraxial procedures. DSA will not prevent other serious complications including intracord injection or hematoma formation. DSA is limited by motion artifacts and the images are subject to human interpretation. Any motion between the initial scout film and subsequent images will be detected as a change, impeding the subtraction process and causing degradation of image quality. Thus, utilization of this technology does not negate the potential for human error nor the potential for patient injury. The false negative rate of live fluoroscopy is unknown, but has been observed in one study to be 0.75%, with a calculated sensitivity of 99.25% and specificity of 100% to detect unintentional vascular injections (5). DSA may provide greater sensitivity and specificity, but the exact limits of detection are unclear and the safety profile is neither fully characterized nor validated.

While the magnitude of differences in radiation exposure associated with DSA versus fluoroscopy has not yet been quantified, extrapolation from the interventional vascular literature suggests that DSA may substantially increase exposure to ionizing radiation, comparable to computed tomography angiography (CTA). Manninen et al (6) compared patient radiation exposure during diagnostic CTA and biplanar DSA ex-

aminations for both cerebral and cervicocerebral vessels. This study demonstrated that for the cerebral vessels and cervicocerebral vessels, the effective dose for DSA was 5 and 3 times greater respectively than CTA.

We applaud the authors for their meticulous performance of the procedure but disagree with the authors' conclusions that "we recommend the use of DSA to observe dynamic contrast [medium] flow during TFESI (1)." Considering the volume of interventional spine procedures performed annually, routine use of DSA may have a poor risk/benefit ratio due to escalated radiation exposure to patients and staff, particularly when rates of preventing rare catastrophic outcomes may reliably be averted by employing other safety measures. Among these, primarily, would be ceasing the use of particulate steroid injections during TFESI. Concerns for efficacy have been recently addressed by Kennedy et al (7) in a multi-center double-blind prospective, randomized trial demonstrating similar efficacy between dexamethasone and triamcinolone for lumbar TFESI.

Conclusion

The routine use of DSA is not warranted based on current medical evidence. DSA use increases exposure

to ionizing radiation, yet the current best literature does not demonstrate that it provides additional detection of arterial injection beyond that provided by traditional live fluoroscopy. The occasional exposure of an individual patient to this increased radiation exposure is still undetermined, yet for a practitioner performing hundreds of procedures/month or year, the cumulative exposure may have grave consequences. Practitioners should consider using dexamethasone as a first line agent in all TFESI.

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In Response

We read your points with particular interest and attention. We share with you the same concerns. In this response we will attempt to answer these lingering questions. The focus of the study was to identify missed vascular flow with traditional methods that is subsequently identified by digital subtraction angiography(DSA). We were able to identify venous

vascular flow missed by traditional methods in 5 of 222 injections (2.25%) (1). Since the DSA step was dependent on the prior steps, i.e., if there was vascular flow detected with any method then the needle was repositioned, thus we were unable to compare the rates of vascular detection by the different methods statistically.

Adding an extra 2.25% improvement in vascular

penetration detection is procedurally relevant. The fact that vascular flow was missed using traditional methods and only picked up on DSA is also significant. We suspect that arterial injection of particulate steroids can lead to spinal cord or cerebral infarcts. The gravity of these complications dictates that we exert maximum efforts for prevention. On the other hand, reports of these complications are considered rare with the total number of transforaminal epidural injections performed as the denominator and the argument as well can be made whether these complications are statistically significant.

Nonetheless, the only reported case of spinal cord infarct after using DSA for transforaminal epidural steroid injections (TFESI) (2) presented some procedural flaws, such as using particulate steroids and no reported use of live fluoroscopy. We advocate always using nonparticulate steroids such as dexamethasone for TFESI. DSA should be performed after a negative vascular flow on live fluoroscopy injection for 2 reasons. First, live fluoroscopy contrast medium injection gives a better anatomic view of the flow. Second, it reduces chances of having to repeat DSA as the majority of the vascular flow can be visualized by live fluoroscopic injection. Technically, with regular use of DSA, operators gain experience to reduce the motion artifact, become more familiar with the images generated, and the identification of vascular flow becomes easier. We also don't believe that the cost of adding a DSA unit to an existing or new fluoroscopy unit is prohibitive.

In regards to visualization of sacral vascular flow detection, the S1 level should not be underestimated since Houten and Errico (3) reported spinal cord infarction after an S1 transforaminal injection.

In regards to patients' and operators' exposure to radiation, there is no argument that the addition of DSA increases the exposure rate. We are not aware of specific studies that evaluated complications of exposure to operators using DSA over a long duration with vari-

able shielding options. Cerebral angiography, vascular, cardiac interventions, and biplanar DSA are very different in duration from TFESI. We use pulsed (8 pulses/s) for live fluoroscopy and low dose continuous mode for DSA. It is unknown if the extra 3 - 10 seconds of exposure would be harmful to patients. Also, it is our experience that adding DSA only after negative vascular flow detection using other methods is a way to keep the radiation dose as low as reasonably achievable. Since we can detect most of the vascular flows with traditional methods, one would have to reposition the needle and repeat the DSA step in only 2.25% of the cases.

Conclusion

The gravity of complications dictates that we exert maximum effort for preventing intravascular injection. We advocate the use of DSA after a negative contrast medium injection on live fluoroscopy and the use of nonparticulate steroids.

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