Ultrasound vs Fluoroscopy in Pain Intervention

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ABSTRACT

Fluoroscopy-guided intervention is the gold standard for chronic pain management. Most of the pain physicians are very comfortable with fluoroscopy-guided procedures. Ultrasonography (USG) is slowly emerging with satisfactory results in the field of chronic pain management. Both have its advantages and disadvantages. Most of the articles are in favor of fluoroscopy for spine procedures, whereas USG is unique in regional nerve block procedures. More studies are required to prove the superiority of one technique over the other.

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ULTRASOUND VS FLUOROSCOPY IN NEURAXIAL BLOCK

There is an established role of fluoroscopy in neuraxial block. Hazra et al in their study showed that fluoroscopy helped visualization of needle tip at S3 (Fig. 1). This is important for drug distribution at the desired level. Fluoroscopy also provided epidurogram showing filling defect (Fig. 2) helping further management for adhesiolysis. With ultrasonography (USG)-guided caudal epidural block (Fig. 3), these observations were not available as the needle tip is obscured by acoustic shadow. Moreover, USG may give a false-positive result. Drawback of fluoroscopy is radiation hazard, which might cause cell mutation and cell death. Drawbacks of USG include its dependence on skilled operator and difficulty in imaging structures behind bone and air. Prenatal sex determination is also a real social problem in India and Prenatal Diagnostic Techniques Act is imposed on its use.

Regarding transformaminal epidural block (Fig. 4), USG guidance is not highly recommended injections due to

Fig. 1: Needle tip at S3

Fig. 2: Epidurogram showing filling defect

Fig. 3: The USG-guided caudal epidural block

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the inability to visualize vasculature within the spinal canal during an injection or assess the depth of the needle once advanced past the bone. The USG in interlaminar or transforaminal epidural injection provides no assurance that the injectate has not been placed intravascularly or that a dural puncture has not occurred.\textsuperscript{3,4} Fluoroscopy delivers the drug very close to the site of discoradicular conflict, the drug is visualized spreading from lateral to medial, if needle placement looks satisfactory; but, if the contrast is only flowing laterally outside the foramen, it may not be beneficial as the drug is not reaching the site of inflammation. Needle placement can be rectified to get better drug placement.\textsuperscript{3,4}

Due to the limited resolution at deep levels and the presence of bony artifacts that limit visualization, USG was considered not as useful in neuraxial (epidural or intrathecal) blocks.\textsuperscript{5} Recently, several groups have demonstrated high success rate using real-time USG guidance.\textsuperscript{6,7}

**ULTRASOUND VS FLUOROSCOPY IN SPINE PROCEDURES**

Both fluoroscopy (Figs 5A and B) and USG (Fig. 6) in lumbar facet joint injections have high success rates. Yoon et al\textsuperscript{3} conducted a randomized control trial, comparing USG and fluoroscopy in the lumbar facet joint injections. Both groups that received fluoroscopic and USG-guided injections showed significant improvement in pain control and return to activities with no significant residual pain. Greher et al\textsuperscript{8} demonstrated that direct visualization of the facet nerve at a 5 cm depth using USG guidance was unable to be performed, but using their method based on a sonographic cross-axis and long-axis view, the authors were able to set the needle target point for a lumbar medial branch nerve block. They also proved that an injection of 1 mL solution resulted in a remarkable spread around the needle tip as confirmed on fluoroscopy. Jung et al\textsuperscript{9} stated 91.6% success rate with fluoroscopy-guided lumbar medial branch block. For cervical facet, USG may be a better option.\textsuperscript{10}

The USG-guided injection of the sacroiliac (SI) joints has been demonstrated to have a high success rate of up to 90%.\textsuperscript{11} After the sacral cornu is identified,
the transducer is moved in a lateral direction until the lateral edge of the sacrum is observed. The transducer is then moved in a cephalad direction until the SI joint is identified.

Fluoroscopy and computed tomography-guided techniques have advantages related to more precise localization of the joint during these procedures. The diagnostic application of USG in the SI joint may be limited because of the significantly lower accuracy rate (87.3%) vs fluoroscopy (98.2%) in a study done by Jee et al. The needle missed to enter the joint in 12.7% of the patients in the USG group.

ULTRASOUND VS FLUOROSCOPY IN PERIPHERAL NERVE INTERVENTION

Fluoroscopy is effective for visualization of bony structures, but not soft tissues. It thus has limitations when performing peripheral procedures. The USG has numerous advantages:

- More affordable and portable avoiding any radiation exposure
- Provides direct visualization of muscles, tendons, ligaments, nerves, vessels, and bone
- Allows visualization of small peripheral nerves and their associated branches
- Real-time USG guidance of needle placement and medication administration provides an advantage in ensuring accuracy
- The USG-guided supraclavicular brachial plexus block in regional anesthesia is very popular. There are more than 1000 publications supporting this
- The USG-guided occipital nerve block, supra scapular nerve block for frozen shoulder, and lateral cutaneous nerve block for meralgia paresthetica have met with high success rate
- The USG identifies musculoskeletal structures, nerves, and vessels accurately and, therefore, compared with fluoroscopy, for peripheral structures, USG is better.

ULTRASOUND VS FLUOROSCOPY IN VISCERAL GANGLION BLOCK (STELLATE GANGLION BLOCK)

The USG allows visualization of all important structures in the neck. The C6 transverse process is identified by its prominent anterior tubercle. Fluoroscopy increases the accuracy of identifying Chassaignac’s tubercle; however, identifying the tissue plane between the longus colli muscle and the prevertebral fascia is not accomplished. Use of fluoroscopy is an improvement, but the critical structures, such as the thyroid gland and the carotid artery might be injured. Vascular structure is not identified by fluoroscopy. Continuous fluoroscopy can detect intravascular injection. The carotid artery must be retracted laterally, and the vertebral artery lies in close proximity; thus, intravascular injection is a real big concern. The USG with Doppler imaging technique is unique in identifying vascular structures. With the use of USG, the great vessels of the neck and the thyroid gland can be directly visualized, and a needle trajectory that avoids these structures can be selected from the start. Any practitioner who has made the transition from blind or fluoroscopically guided stellate ganglion block (Fig. 7) to USG guidance (Fig. 8) will attest that the technique has been tremendously simplified and the safety of the technique made more certain.

The USG and fluoroscopy both have their merits and demerits:

- For spine procedures, fluoroscopy is always a better option, whereas USG is a better option for peripheral nerve block and visceral ganglion block.
• The USG needs expertise, whereas fluoroscope can be learnt by a beginner as it includes only a short learning curve.
• The USG works better to identify neurovascular bundle, whereas the fluoroscope identifies bone only.
• The USG avoids radiation hazards and is applicable to pregnant patient, children, and the young.

REFERENCES