

Complication during Ultrasound-guided Regional Block: Accidental Intravascular Injection of Local Anesthetic

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ULTRASOUND-GUIDED regional blocks are becoming increasingly popular among anesthesiologists. The ultrasonographic image allows real time visualization of anatomical structures, the progression of the needle, and the spread of the injected local anesthetic (LA). The visualization capabilities of ultrasound guidance (USG) are thought to increase the safety of regional blocks when compared with a landmark-guided approach,¹ possibly reducing the risks associated with paresthesia, as well as the frequency of intraneural or intravascular injection of LA drugs. The additional information provided by USG, coupled with the anatomical modifications resulting from the pressure exerted by the ultrasound probe, may also add to or alter the clinical presentation of these adverse events. We present a case of accidental intravascular injection of LA during axillary block, which occurred despite the use of USG. This case demonstrates that although proper use of USG may increase safety compared with landmark-guided peripheral blocks, the risks associated with injection of large amounts of LA are not entirely abolished. The use of USG does not obviate the need for standard safety measures and may alter the effectiveness of traditional signs of intravascular injection.

Case Report

A 57-yr-old woman, American Society of Anesthesiologists physical status I, was scheduled to undergo a right wrist trapeziectomy during regional anesthesia. An ultrasound-guided axillary block was proposed, for which the patient gave informed consent. Standard monitoring was instituted and peripheral intravenous access was obtained. Oxygen was administered through nasal prongs, and sedation was achieved with fentanyl (75 µg intravenous) and midazolam (1 mg intravenous).

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Axillary block was performed by a senior resident with previous experience of more than 30 ultrasound-guided blocks. With the patient in dorsal decubitus with the right arm abducted at 90°, a 50-mm, short bevel, atraumatic, 22-gauge coated needle (Stimuplex®; B. Braun, Bethlehem, PA) was used. The LA solution was a mixture of lidocaine and bupivacaine hydrochlorate (1.5% and 0.125% final concentrations, respectively) with epinephrine (1:200,000). A 7.5- to 13-MHz, 31-mm ultrasonic linear scanning head (Aloka Co., Tokyo, Japan) was used to visualize the axillary artery. The visualization and puncture sites were located as close as possible to the lateral border of the pectoralis major, and the advancement of the needle tip was monitored under direct ultrasonic visualization (out of plane approach). Continuous aspiration was applied during progression of the needle. No paresthesia was elicited, and neurostimulation was not used. The LA was injected both lateral and medial to the axillary artery (perivascular technique).

Fifteen milliliters of LA was uneventfully injected on the lateral aspect of the axillary artery. Aspiration through the needle, performed every 5 ml, was negative for blood. The location of the tip of the needle and the dispersion of the LA around the artery were judged to be adequate throughout the injection. The needle was then repositioned under USG immediately medial to the axillary artery. Again, incremental injection of LA was performed, and LA deposition was visualized for the first 10 ml that was injected. However, when the last 5 ml of LA was injected, dispersion was not visualized. The ultrasound probe was removed, and as the needle was withdrawn from the patient's arm under aspiration a small amount of blood appeared in the syringe. Within a few seconds of needle withdrawal, the patient reported discomfort and dizziness. Over the next minute, the heart rate gradually increased from 86 to 150 beats/min (sinus rhythm), and blood pressure increased from 120/83 to 280/130 mmHg. She became agitated and then gradually lost consciousness over a 2-min period. Mild uncoordinated movements of the limbs were observed, but no frank tonic-clonic seizure type activity was observed. The patient's ventilation was easily assisted by bag-mask, and the oxygen saturation remained at 99% throughout the event. Medication or tracheal intubation was not necessary, because the patient's vital signs returned to normal and she recovered consciousness 5 min after the end of LA injection without any further complications.

Discussion

We present a case where, despite using USG during axillary block, a small amount of LA seems to have accidentally infused intravascularly. In this case, what appeared initially to be a block performed with a correct technique seems to have accidentally resulted in intravenous injection of 5 ml of LA. When performing regional anesthesia, recommendations exist to avoid a worst-case scenario: massive intravascular injection. These recommendations include (1) slow and fractionated injection of LA doses, (2) frequent aspiration through the needle to detect intravascular placement, and (3) use of solutions containing low-dose epinephrine combined with monitoring of heart rate. USG may further lower the risk of accidental intravascular injection of LA by providing in-

formation not available using neurostimulation alone: a real-time view of the spread of the LA, which may permit early detection of inappropriate deposition before toxic doses are injected.² When performing ultrasound-guided blocks, a prospective study has identified reproducible patterns of technical errors,³ including failure to visualize the needle in the process of reaching the target structures, failure to evaluate structures using color-flow analysis, and incorrect identification of structures. In addition, ultrasound probes appropriate to the technique being performed should always be used (*i.e.*, 5- to 12-MHz probe for brachial plexus blocks²⁻⁴), the unique anatomy of each patient should be evaluated before performing the block, LA spread should always be monitored, and if a problem is identified during injection, the needle should be repositioned before pursuing LA injection.^{2,5,6}

In retrospect, the nonvisualization of the last 5 ml of LA being injected, combined with aspiration of blood through the needle when the ultrasound probe was removed, were very probably signs pointing to intravascular injection. The clinical scenario that immediately followed LA injection suggests that the final 5 ml of LA solution was injected intravascularly. An explanation for this sudden intravascular passage of the needle could be that the tip of the needle moved into a compressed (thus echographically invisible) vascular structure at the end of the injection sequence. Alternatively, small involuntary movements of the needle by the anesthesiologist may have led to its insertion into a vascular structure during injection of the LA. Mild pressure with the ultrasound probe over the axillary neurovascular plexus is sufficient to collapse small compressible veins to such an extent that one cannot visualize them with ultrasound. As Gray⁷ has previously suggested, LA injection may displace such vascular structures, which could then reach the tip of the needle. An alternate explanation for the signs of LA toxicity presented in this case is rapid uptake of the total LA dose into systemic circulation. The rapid onset and offset of the toxicity, combined with the adherence to recommended total dosing of LA and the absence of anatomical anomalies in the region of injection that could enhance systemic uptake,⁸ make this explanation less likely in our opinion. Unfortunately, measurement of

LA blood levels was not available in our institution at the time this case occurred.

In conclusion, our patient report and recent literature reports suggest that USG during performance of nerve blocks does not completely eliminate the risk of accidental intravascular or intraneural^{9,10} injection, and underscores the importance of strict adherence to all safety recommendations regarding the injection of LA during ultrasound-guided regional blocks. Direct visualization of neurovascular structures, the block needle, and LA spread do not completely eliminate the danger of accidental intravascular injection. It should never be assumed that spread of LA outside the plane of examination of the ultrasound probe explains the sudden disappearance of LA previously visualized spreading from the needle tip. Compressed venous structures may be difficult or impossible to see with ultrasound and may be displaced by LA injection. Slow, fractionated injection should therefore continue to be adhered to even when USG is used as an aid for regional anesthesia. Finally, practitioners should be highly suspicious of a negative aspiration test when ultrasound does not clearly show LA spread, because aspiration may not be as reliable in the presence of venous compression by the ultrasound probe.

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