DOSE REQUIREMENT OF LOCAL ANAESTHETIC TO PRODUCE GRAND MAL SEIZURE DURING STELLATE GANGLION BLOCK

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ABSTRACT

Two case reports illustrate that low doses of local anaesthetics such as bupivacaine 2.5 mg and a mixture of bupivacaine 1.25 mg and lidocaine 5 mg can induce grand mal seizures if injected into the vertebral artery during stellate ganglion block.

The effect of the dose of local anaesthetic agent and technique of administration into the stellate ganglion region discussed as is the relationship between vertebral artery blood flow and cerebral intravascular local anaesthetic concentration required to produce seizure activity. Suggestions are made concerning possible modification of the technique of anterior approach to the stellate ganglion, including test dose size, to reduce the incidence of inadvertent injection into the vertebral artery and subsequent central nervous system toxicity.

KEY WORDS: ANAESTHETIC TECHNIQUES, regional, stellate block; COMPLICATIONS, convulsions, local anaesthetics.

THE ANTERIOR paratracheal approach at C6[1] is a technique commonly employed for blockade of the stellate ganglion. One of the serious potential complications with the use of this technique is inadvertent injection of the local anaesthetic solution into the vertebral artery. Previous case reports indicate that doses of bupivacaine as low as 7.5 mg and probably lidocaine 10 mg can produce grand mal seizures when injected into the vertebral artery.[2,3] The symptoms associated with inadvertent injection of local anaesthetic into the vertebral artery range from transient nausea, dizziness, slurred speech and sedation to temporary blindness, loss of consciousness and, finally, grand mal seizures.

The following two case reports document grand mal seizures that occurred during stellate ganglion block with doses of local anaesthetic much lower than those previously reported. The effect of mass of local anaesthetic agent and technique of administration of the drug into the stellate ganglion region is discussed, as is the relationship between vertebral artery blood flow and cerebral intravascular local anaesthetic concentration required to produce seizure activity.

Based on two case reports, some suggestions are made concerning possible modification of the technique of anterior approach to the stellate ganglion, including test dose size, to reduce the incidence of inadvertent intravertebral artery injection and subsequent central nervous system toxicity.

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CASE REPORTS

Case I

A diagnostic stellate ganglion block was planned for a 55 year old 60 kg man with diffuse burning pain in the left upper extremity.

An intravenous infusion was established in the opposite arm. The patient was placed in a 20 degree head up position and the neck was fully extended. A paratracheal approach was used with a 25 gauge 3.75 cm needle attached to a 10 ml syringe. Bony contact was made at the level of C6 and the needle was then withdrawn 3 mm. Following negative aspiration, a test dose of 0.5 ml of bupivacaine 0.5 per cent was injected.

Within five seconds after the injection generalized rigidity developed, which was followed by a grand mal seizure. The seizure lasted approximately 15 seconds and was associated with urinary incontinence. No residual

sequelae were noted five minutes after the seizure. Follow-up neurological assessment and electroencephalogram were normal.

Case II

A 40 year old 50 kg woman with a three year history of post-traumatic reflex sympathetic dystrophy and disuse atrophy of the left arm was scheduled for a diagnostic stellate ganglion block. A series of stellate ganglion blocks one year previously had been partially effective in relieving her symptoms.

Preparation again included establishing an intravenous infusion in the right arm and placing the patient in a 20 degree head up position with the neck extended. A paratracheal approach at the C6 level was used with a 25 gauge 3.75 cm needle on a 10 ml syringe. After what appeared to be an appropriate placement of the needle and a negative aspiration, a test dose consisting of a mixture of 0.25 ml of bupivacaine 0.5 per cent and 0.25 ml of lidocaine 1.0 per cent was injected. Within five seconds after injection the patient became restless and stated that she "saw red." No images could be visualized. At this time her eyes were open and both pupils were dilated. This was followed within five seconds by generalized rigidity progressing rapidly to a grand mal seizure.

The needle was immediately withdrawn. The head of the bed was lowered to the supine position and oxygen was administered by mask. The total duration of the seizure was less than one minute and was followed by complete recovery. Duration of blindness was estimated to be approximately three minutes, with complete recovery of vision. No neurological sequelae could be detected on follow-up examination.

Discussion

The two cases reported here serve to illustrate that grand mal seizures might follow the injection of very low doses of local anaesthetic–presumably into the vertebral artery.

In Case I, 2.5 mg of bupivacaine and in Case II, 1.25 mg of bupivacaine in combination with lidocaine 5 mg were injected. In both cases, the volume of the injection was less than 1 ml (0.5 ml). Previous authors have reported that low doses of local anaesthetic injected into the vertebral artery induce grand mal seizures. In these two cases, much lower doses were followed by a grand mal seizure. This is not a surprise when one considers that vertebral artery blood flow is 20 per cent of the total cerebral blood flow. In Case I, the injection of bupivacaine 2.5 mg could produce a regional concentration as high as 400 μg/ml of bupivacaine for several seconds. Despite the brief exposure of the brain to these high concentrations, the high lipid solubility of bupivacaine (oil/water partition co-efficient of 3.4) accounts for its rapid diffusion through the blood brain barrier. This transient high regional cerebral intravascular concentration of bupivacaine is sufficient to produce central nervous system toxicity. Our calculations are similar to those Szeinfeld *et al*[4] in a case report of transient reversible blindness which also occurs following the injection of a dose of bupivacaine of as little as 2.5 mg into the vertebral artery.

During a stellate ganglion block, it is often difficult to immobilize the needle absolutely, so that the needle tip might slip into the vertebral artery resulting in intravascular injection of local anaesthetic. Moreover, it is difficult to ascertain the exact amount of local anaesthetic that can reach the vertebral artery. When a 25 gauge 3.75 cm needle is used, aspiration of blood is difficult. Moore[5] has reported that 1 to 2 ml of a solution of one per cent mepivacaine injected into the vertebral or the carotid artery could, in most cases, cause the patient to complain of nausea, vomiting, sedation. He further suggested that one should aspirate for blood, recheck landmarks and proceed carefully. If signs and symptoms persist, one should temporarily discontinue the block. Since it is difficult to ascertain the amount of anaesthetic injected into the vertebral artery, the symptoms described by Moore and others might have occurred as a result of the injection of volumes smaller than 1 to 2 ml into the cerebral arterial circulation.

Studies with the use of a side-port needle (Whittaker or Galindo) are currently in progress.[6] These needles have the port for injection approximately 3 mm from the needle tip. The needle can then be placed against the C6 transverse process and held immobile. Aspiration and injection can be done without needle movement.

All air should be purged from the needle and the needle end of the syringe before injection to ensure that, if injection into the vertebral artery should occur, air embolism will not result. Injection of air into the vertebral artery might also be a cause of transient central nervous system disturbance.

Based on the cases reported, we suggest that a

test dose following a negative aspiration should be limited to less than 0.5 ml of local anaesthetic (preferably to 0.25 to 0.3 ml). The test dose with bupivacaine should not exceed 0.125 mg and with lidocaine should be 5 mg or less. These doses do not guarantee that seizures will not occur following inadvertent vertebral artery injection. However, if seizures do occur, they are likely to be very short-lived. Frequent aspiration should be employed during injection of the final volume of drug. Since even with careful aspiration intraluminal placement of the 25 gauge needle might not be apparent, we prefer to use a 22 gauge 3.75 cm needle for stellate ganglion block.

The cases reported re-emphasize the importance of keeping the patient fasting before a stellate ganglion block, establishing an intravenous infusion and having resuscitation equipment readily available.

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RÉSUMÉ

De faibles doses d'anesthésiques locaux injectées accidentellement dans une artère vertébrale au cours d'un bloc stellaire peuvent déclencher des convulsions du genre observé dans le grand mal épileptique. Cette complication a été observée chez deux malades qui ont reçu des doses respectives de 2.5 mg de bupivacaïne et de 1.5 mg de bupivacaïne avec 5 mg de lidocaine lors de l'injection-test précédant l'administration de la dose totale d'anesthésique local.

En discussion, les doses d'agents anesthésiques utilisées et la technique d'administration de ces agent lors de blocs stellaires, la contribution des artères vertébrales au débit sanguin cérébral, et les concentrations d'anesthésiques locaux dans la circulation cérébrale susceptibles de provoquer des convulsions font l'objet de commentaires. On propose ensuite des suggestions pour diminuer l'incidence des injections intra-vertébrales au cours des blocs stellaires (emploi d'aiguilles à site d'injection latéral éloigné de la pointe et volume des doses-test utilisées).