Regional Anesthesia and Pain

Successful defibrillation immediately after the intravascular injection of ropivacaine

[Défibrillation réussie immédiatement après l'injection intravasculaire de ropivacaine]

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Purpose: To report successful resuscitation of ventricular fibrillation induced by accidental intravascular injection of ropivacaine.

Clinical features: A 15-yr-old healthy girl weighing 59 kg was scheduled for transposition of the tibial tuberosity under combined sciatic/three-in-one block. No premedication was given. In the induction room, an iv infusion was started, along with electrocardiogram monitoring, non-invasive blood-pressure measurement and pulse-oximetry. The sciatic nerve was found with the use of a nerve stimulator at the first attempt by the classical approach of Labat. Aspiration for blood was negative and the injection of ropivacaine 0.75% without epinephrine started. Convulsions, followed within seconds by ventricular fibrillation occurred at the end of the injection of 18 mL ropivacaine 0.75%. Oxygen was administered by face mask ventilation and immediate defibrillation was successful on the second attempt (2×200 joules). Within two minutes convulsions stopped and normal cardiac rhythm returned. Propofol and sufentanil were injected and a laryngeal mask inserted to start general anesthesia for surgery. Postoperatively no evidence of sciatic block could be demonstrated. The patient did not remember the event and was discharged the following day with no residual effects.

Conclusion: This case report shows that ventricular fibrillation after unintentional intravascular injection of ropivacaine can be treated successfully when one is prepared and cardiac life support measures are taken immediately.

Objectif : Présenter une réanimation réussie à la suite d'une fibrillation ventriculaire induite par l'injection intravasculaire accidentelle de ropivacaine.

Éléments cliniques : Une jeune fille de 15 ans, pesant 59 kg, devait subir la transposition de la tubérosité tibiale antérieure sous bloc combiné sciatique/trois-en-un. Elle n'a reçu aucune prémédication. Une perfusion iv a été amorcée, de même que le monitoring de l'électrocardiogramme, la mesure non effractive de la tension artérielle

et la sphygmo-oxymétrie. Le nerf sciatique a été repéré au premier essai par neurostimulation selon l'approche traditionnelle de Labat. L'aspiration du sang était négative, nous avons commencé l'injection de ropivacaine à 0,75 %, sans épinéphrine. Des convulsions, suivies quelques secondes plus tard de fibrillation ventriculaire, sont survenues à la fin de l'injection de 18 mL de ropivacaine à 75 %. De l'oxygène a été administré par ventilation au masque et la défibrillation immédiate a été réussie au deuxième essai (2×200 joules). En moins de deux minutes, les convulsions ont disparu et le rythme cardiaque est revenu à la normale. Du propofol et du sufentanil ont été injectés et un masque laryngé inséré pour commencer l'anesthésie générale et l'intervention chirurgicale. Aucune évidence de bloc sciatique postopératoire n'a été démontrée. La patiente n'a pas eu conscience de l'incident et elle a quitté l'hôpital le jour suivant sans atteintes résiduelles.

Conclusion : La fibrillation ventriculaire causée par une injection intravasculaire accidentelle de ropivacaine peut être traitée avec succès quand on est préparé et que les mesures de réanimation cardiaque sont immédiatement appliquées.

ROPIVACINE shows less central nervous system toxicity and cardiotoxicity than bupivacaine in animal and human studies.¹⁻³ In animals, ropivacaine-induced cardiac arrest can be treated successfully.¹ Patients may also respond readily to resuscitation to severe systemic toxicity induced by ropivacaine. We report a case of ventricular fibrillation induced by ropivacaine during an attempted sciatic nerve block where resuscitation was successful by immediate defibrillation.

Case report

A 15-yr-old healthy girl weighing 59 kg was scheduled for transposition of the tibial tuberosity. During the

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preoperative interview the patient had decided to undergo the operation under combined sciatic/three-in-one block. No premedication was given. In the induction room, an *iv* infusion was started, along with electrocardiogram (ECG) monitoring, non-invasive blood-pressure measurement and pulse-oximetry. The patient was then asked to turn onto the side for the sciatic nerve block. The sciatic nerve was found with the use of a nerve stimulator (settings: 0.4 mA, 0.1 msec, 2 Hz) on the first attempt by the classical approach of Labat.⁴ Aspiration for blood was negative. After injection of 2 mL of ropivacaine 0.75% the muscle contractions disappeared and a repeated attempt to aspirate blood was negative. After the injection of a total dose of 18 mL ropivacaine 0.75% without adrenaline (a dose of 2.28 mg·kg⁻¹) generalized convulsions developed, followed within seconds by ventricular fibrillation. Oxygen was administered by face mask ventilation and defibrillation was successful on the second attempt (2 × 200 joules). Within two minutes of the onset of symptoms all hemodynamic variables normalized. After this rapid and successful resuscitation we decided to continue surgery as planned, however with general anesthesia. Propofol 150 mg *iv* and 5 µg sufentanil *iv* were administered and a laryngeal mask airway inserted. Maintenance of anesthesia was achieved with sevoflurane, N₂O /O₂: 2/1, and additional sufentanil (15 µg *iv* boluses as needed). Postoperatively the patient awoke rapidly and did not remember the event. She complained of pain and no evidence of sciatic block could be demonstrated. The following day she was discharged as planned with no residual effects.

Discussion

This is the first report of the successful, immediate defibrillation of ventricular fibrillation induced by ropivacaine. Ropivacaine shows less cardiotoxicity than bupivacaine in animal and human studies.¹⁻³ However, it is a potent local anesthetic and ropivacaine-induced convulsions, cardiac dysrhythmias and even cardiac arrests have been described after unintentional intravascular injection during peripheral nerve blocks.⁵⁻¹² In a recent case report by Klein *et al.* successful resuscitation after ropivacaine-induced ventricular fibrillation was described where resuscitation measures were successful without defibrillation.¹³ Defibrillation was planned, but with the use of oxygen, propofol, intubation and chest compression, the circulation returned before the defibrillator was ready to use. Both cases show that after ropivacaine-induced ventricular fibrillation resuscitation is successful if all measures of cardiac life support (CLS) are taken. Our

experience with this patient shows that immediate administration of oxygen and defibrillation is a treatment to consider in case of ventricular fibrillation caused by a potent local anesthetic such as ropivacaine.

Several case reports of central nervous system symptoms and cardiovascular symptoms after the unintentional intravascular injection of ropivacaine in relation to upper extremity blocks⁸⁻¹⁰ and lower extremity blocks^{5-7,11-13} have been published. Interestingly, five cases occurred during an attempted sciatic nerve block.^{5-7,12,13} The sciatic nerve is the largest in the body, has a rich blood supply and is surrounded by large arteries and veins. Hence an accidental intravascular injection can easily occur. The addition of epinephrine to ropivacaine does little to enhance the quality of a block, but can help to detect an intravascular injection. Repeated aspirations for blood are no guarantee and a very slow injection is the best preventive measure to avoid an accidental intravascular injection. Central nervous symptoms in an awake or lightly sedated patient will alert the anesthesiologist before cardiovascular collapse occurs. In this case the local anesthetic was, perhaps, injected too quickly because the patient was nervous and moving. Also, verbal contact with the patient was not optimal as the father was with the patient and talked to her during the injection. It is most important to have the undivided attention of the patient when injecting the local anesthetic. Unfortunately we relied on the father in this case.

Blood concentrations of ropivacaine show wide variation after an unintentional intravascular injection because they are measured at various times after the accident and also, in most cases, it is not known how much of the local anesthetic was injected intravascularly. Patient sensitivity also differs, as shown in volunteer studies;^{2,3} neurological signs were seen between 0.5 to 2 mg·L⁻¹ but in the study of Knudsen³ one volunteer tolerated a plasma level of 3.2 mg·L⁻¹. A "safe" dose of ropivacaine is considered to be 3 to 4 mg·kg⁻¹ for peripheral nerve blocks, e.g., 300 mg for a brachial plexus block in an adult patient. However, we routinely administer for a combined block (sciatic nerve block and femoral nerve catheter) 50 to 60 mL ropivacaine 0.75% for knee replacement surgery in an adult patient (5–6 mg·kg⁻¹). Using these high doses, we have seldom seen clinical symptoms of systemic toxicity from absorption. Accordingly, when convulsions and cardiac disturbances occur immediately after injection of the local anesthetic, it must be the result of an intravascular injection. When convulsions occur much later after the injection of a large dose it is more likely the result of absorption.

In conclusion, the case presented and that of Klein *et al.*¹³ demonstrate clearly that ropivacaine-induced ventricular fibrillation can be treated successfully when one is prepared and CLS measures are taken immediately. ECG monitoring is essential and "safer" ropivacaine is potentially lethal if not used properly.

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