Inadvertent epidural administration of potassium chloride. A case report

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A 24-year-old black female presented for repeat elective Caesarean section. The procedure was performed under epidural anaesthesia. Sufentanil 25 µg, intended for postoperative analgesia, was inadvertently diluted to 10 ml with 15 per cent potassium chloride (KCl) instead of preservative-free normal saline (0.9 per cent NaCl). This solution was then injected via an epidural catheter into the epidural space at the conclusion of surgery. Two hours after injection of the sufentanil-KCl mixture, the patient had a level of sensory blockade to T₁ and diaphoresis above this level. Painful muscle spasms had also developed below T₁. One hour later she developed hypertension which required hydralazine 10 mg and labetalol 25 mg IV for treatment. The patient was treated supportively with oxygen. Dexamethasone 10 mg was administered intravenously to reduce spinal cord oedema. Intravenous diazepam 10 mg and meperidine 75 mg were given for sedation and analgesia. Complete recovery occurred within 12 hours.

Epidural narcotic administration for postoperative analgesia is rapidly gaining in popularity.¹⁻³ For maximal effect, narcotics must be injected into the epidural space in volumes of 8-12 ml.* Most narcotics currently injected into the epidural space require dilution to achieve this volume. Errors can occur in choosing the diluent.⁴

To date, there are three reports in the literature describing the inadvertent administration of varying concentrations of potassium chloride (KCl) into the epidural space.⁵⁻⁷ These reports describe the prolonged or permanent nature of the neurological block and muscle spasms associated with epidural KCl.

A patient in our institution had sufentanil 25 µg inadvertently diluted with 15 per cent KCl 10 ml injected into the epidural space. As well as features already discussed in association with epidural KCl administration this patient demonstrated marked autonomic dysfunction.

Case report

A 24-year-old G₂P₁ black female at 39+ weeks gestation was admitted for repeat elective Caesarean section. Her first Caesarean section was performed for cephalopelvic disproportion.

She was healthy and had had a totally uneventful pregnancy. Physical examination was normal. The patient was normotensive preoperatively. There were no laboratory abnormalities.

Epidural anaesthesia was performed. The initial attempt at L₂₋₃ was unsuccessful because the epidural space could not be identified. An 18 gauge catheter was passed easily through a Tuohy needle at the L₃₋₄ interspace after identification of the epidural space by a loss of resistance technique. After a negative aspiration test, two per cent lidocaine 2 ml was administered as a test dose. After a five minute interval, 5 ml aliquots of carbonated lidocaine with 1: 200,000 epinephrine were

Key words

ANAESTHETIC TECHNIQUES: epidural; RISK MANAGEMENT: potassium chloride administration; COMPLICATIONS: muscle spasms, haemodynamic instability, diaphoresis.

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*Arcurio J, Vartikar J, Johnson M, Lemal M, Ostheimer GW, Naulty JS. The effect of diluent volume on analgesia produced by epidural fentanyl. Abstract, SOAP Annual Meeting 1987.

injected over 15 minutes. Total volume injected was 17 ml. Sensory block to T₄ was obtained bilaterally.

The operation was well tolerated and after delivery 25 µg of sufentanil was injected through the catheter for postoperative analgesia.

This narcotic was inadvertently diluted with 15 per cent KCl 10 ml (2 mEq·ml⁻¹) instead of preservative-free normal saline (0.9 per cent NaCl). The KCl vial had been left on the anaesthetic cart. Only the colour of the label (purple) and not the contents of the vial was noted prior to adding it to the sufentanil. About two hours later, the patient began to complain of tingling in both arms. Clinical assessment revealed a bilateral block to T₁ with weak handgrips and decreased sensation. Marked diaphoresis was noted in the upper limbs and face. One hour later the patient's sensory and motor block had progressed cephalad and included the distribution of median as well as ulnar nerves bilaterally. Approximately three hours after administration of the epidural sufentanil-KCl mixture, her blood pressure had increased to 200/110 and her heart rate to 100 beats·min⁻¹. Antihypertensive treatment was started with hydralazine 10 mg IV, and then the blood pressure settled at 160/100 mmHg after a total labetalol dose of 25 mg IV. She remained tachycardic at a rate of 120·min⁻¹.

The medications the patient had received were carefully checked. It became apparent that 15 per cent KCl instead of 0.9 per cent NaCl had inadvertently been injected into the epidural space as the diluent for the sufentanil. Physical examination revealed further progression of the block. The triceps jerks were now absent bilaterally. The patient had flaccid paraplegia in her lower limbs with loss of deep tendon reflexes. She became lightheaded and nauseated on assuming the upright position. She was also very diaphoretic in the upper limbs and face.

A neurologist was consulted. He advised dexamethasone 10 mg IV to reduce possible spinal cord oedema. Arterial blood gases were also suggested because of potential sickling and the possibility of previous laboratory error (the patient's subsequent repeated sickle cell test proved negative). Her PaO₂ was 66 and her PaCO₂ 28 (FiO₂ 0.21). Supplemental oxygen was administered via nasal prongs.

The patient began having severe painful leg spasms. A total of diazepam 10 mg and meperidine 75 mg were administered intravenously for sedation and analgesia. Six hours post-injection, the patient regained some movement of both legs. A further three hours later she had full range of movement and normal strength in her legs.

Over the course of the next 12 hours, the patient's blood pressure was quite labile, ranging between 90/60 mmHg

and 170/110 mmHg. She also remained tachycardic (up to 130·min⁻¹) as the neurological block gradually receded.

By the following morning, there were no further neurological deficits and the signs of autonomic hyperactivity had resolved. Bladder function could not be assessed initially, as she had a foley catheter in place but subsequently showed no abnormality. The patient was no longer diaphoretic and she was able to walk normally.

The patient was discharged on the sixth postoperative day in good condition.

Discussion

Potassium has been added to local anaesthetic solutions in an attempt to shorten latency and improve the quality of block.^{8,9} The solutions used were of physiological concentrations, yet when similar potassium-containing solutions were injected into the subarachnoid space in dogs, intense muscular spasms and twitches occurred that lasted more than one hour.⁸ These spasms were masked by a two per cent lidocaine solution (volumes 2–5.5 ml), which produced flaccid paralysis throughout its period of activity.⁸

The patient in the case we report did not experience painful leg spasms until approximately two hours following the epidural KCl administration. This delay in onset was possibly due to the concurrent administration of sufentanil, or residual local anaesthetic effect.^{5,8} Once it was recognized that the patient had had an epidural injection of a KCl solution, supplemental oxygen via nasal prongs and intravenous dexamethasone 10 mg were administered in an effort to improve oxygenation and reduce spinal cord swelling. The use of normal saline in an attempt to dilute the concentration of subarachnoid KCl has resulted in raising the sensory level of blockade⁵, so it was not used in this case.

The case presented differs from those already discussed in the literature in the degree of autonomic dysfunction.^{5–7} The case reported by Shanker *et al.* where KCl 15 ml in a concentration of 11.25 per cent was injected into the epidural space has some similarities to the present case.⁶ Their patient required artificial ventilation and became unconscious about two hours after epidural administration of the KCl. Her pupils became dilated and nonresponsive to light. The explanation given in their report hinged on rostral spread of the KCl solution.

Our patient received a total of 20 mEq KCl in a volume of 10 ml into the epidural space. She had marked blood pressure and heart rate changes, yet remained conscious. The present solution may have periodically resulted in a sufficiently depolarizing or hyperosmolar effect on the autonomic neurons to cause the wide pressure changes seen.⁶

Although oxygen and corticosteroids were administered in an effort to maintain oxygenation and reduce spinal cord swelling, these measures have not been shown to improve outcome.⁵ In the absence of any recognized superior treatment, however, it does seem reasonable to administer corticosteroids systemically.

Whether permanent neurologic damage will result from injection of KCl is probably a function of the subarachnoid potassium level.⁶ To ensure against inadvertent injection of KCl we have removed all potassium chloride vials from our obstetric suite. We now use intravenous solutions containing premixed KCl. Although it may be possible to infuse a large amount of potassium rapidly through the use of these solutions, we consider it safer than to have KCl vials available as additives to various solutions. Only preservative-free 0.9 per cent NaCl is kept in the obstetrical suite. All personnel must, in all circumstances, read all labels of all drugs to be administered so that potential disasters from drug administration errors will be prevented.

In summary, we report a case of inadvertent epidural potassium chloride administration. The patient suffered the muscular spasms that have been associated with subarachnoid KCl injection, although there was no evidence that the catheter was in the subarachnoid space. The patient also demonstrated marked autonomic lability. Primary treatment was with supplemental oxygen and intravenous dexamethasone. Sedation and analgesia were achieved by diazepam and meperidine intravenously. Hypertension was managed with intravenous hydralazine and labetalol. The patient recovered without permanent neurologic sequelae.

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References

- 1 Yeager MP, Glass DD, Neff RK, Brinda-Johnson T. Epidural anesthesia and analgesia in high-risk surgical patients. *Anesthesiology* 1987; 66: 729-36.
- 2 Justins DM, Francis D, Moulton PG, Reynolds F. A controlled trial of extradural fentanyl in labour. *Br J Anaesth* 1982; 54: 409-14.
- 3 Cousins MJ, Mather LE. Intrathecal and epidural administration of opioids. *Anesthesiology* 1984; 61: 276-310.
- 4 Gaba DM, Maxwell M, DeAnda A. Anesthetic mishaps: breaking the chain of accident evolution. *Anesthesiology* 1987; 66: 670-6.
- 5 Lin D, Becker K, Shapiro HM. Neurologic changes following epidural injection of potassium chloride and diazepam: a case report with laboratory correlations. *Anesthesiology* 1986; 65: 210-2.
- 6 Shanker KB, Palkar NV, Nishkala R. Paraplegia following epidural potassium chloride. *Anaesthesia* 1985; 40: 45-7.
- 7 Bromage PR. Epidural analgesia. Philadelphia, WB Saunders Co., 1978: 662-63.
- 8 Bromage PR, Burfoot MF. Quality of epidural blockade II: influence of physico-chemical factors hyaluronidase and potassium. *Br J Anaesth* 1966; 38: 857-65.
- 9 Parris MR, Chambers WA. Effects of the addition of potassium to prilocaine or bupivacaine. *Br J Anaesth* 1986; 58: 297-300.

Résumé

Une femme de race noire âgée de 24 ans s'est présentée pour une césarienne élective. La procédure fut accomplie sous anesthésie épidurale. Du sufentanil 25 µg, dans le but d'être utilisé pour l'analgésie postopératoire, fut dilué par inadvertance à 10 ml avec 15 pour cent de chlorure de potassium (KCl) au lieu de la solution physiologique libre de préservatif (0.9 pour cent NaCl). Cette solution a été injectée à travers le cathéter épidural dans l'espace épidural à la fin de la chirurgie. Deux heures après l'injection de la solution KCl-sufentanil, la patiente a présenté un blocage sensoriel jusqu'à T₁ et une diaphorèse au-delà de ce niveau. Des spasmes musculaires douloureux ont aussi été observés en bas de T₁. Une heure plus tard elle développa une hypertension requérant de l'hydralazine 10 mg et du labétolol 25 mg par voie intraveineuse. La patiente a reçu aussi de l'oxygène. Du dexaméthasone 10 mg a été administré par voie intraveineuse afin de réduire l'œdème médullaire. Du diazépam 10 mg et de la mépéridine 75 mg ont été administrés par voie intraveineuse pour fin de sédation et d'analgésie. Une récupération complète est survenue en dedans de douze heures.