

Use of Non-pharmaceutical Grade Compounds in Live Vertebrate Animals

Standard Procedures for Euthanasia Using Saturated Potassium Chloride (KCl) Solution

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Background on Compound

A non-USP saturated or supersaturated solution of KCl may be administered parenterally to produce euthanasia in anesthetized animals. Although KCl is quite safe when administered orally, it is lethal at 75-150 mg/kg IV. Injection of a lethal dose of KCl produces death by cardiac arrest. KCl eliminates the potassium concentration gradient in cardiac muscle, and the depolarized muscle cannot repolarize. Because cardiac arrest by itself does not meet the criteria for euthanasia, the use of KCl for euthanasia is restricted to animals under general anesthesia.

KCl is available as a USP drug for IV administration to correct electrolyte imbalance. However, the solutions used for therapeutic administration contain around 80 mg/ml (2mEq/ml) KCl. The saturated or supersaturated solutions of KCl used for euthanasia contain in excess of 130 mg/ml. The high levels of KCl contained in the non-USP solution are needed to ensure rapid and irreversible death.

Requirements for Use of Compound

1. KCl use must be described in an ASC protocol and **reviewed and approved** before its use.
2. KCl use is allowed only in **anesthetized animals** (surgical or deeper plane of anesthesia).
3. Personnel who administer KCl for euthanasia must be **trained and knowledgeable** in anesthesia for the species to be euthanized to ensure an adequate level of animal unconsciousness prior to KCl administration.
4. KCl is to be administered **intravenously (IV) or intra-cardiac (IC)** in an anesthetized animal.
5. KCl must be **prepared, used, stored, and disposed of** as described in DCM Guidelines that follow;

Preparation of Compound

Ingredients:

- Potassium chloride (CAS # [7447-40-7](#)); white crystalline solid;
- Tap or deionized water.

KCl is quite soluble in water. To make a supersaturated solution of KCl, add 130 g to 1L of solution (tap water, deionized water or sterile water) at room temperature. A precipitate should be present after thoroughly mixing this solution. If a precipitate is not present after mixing, add an additional 50 g KCl to formulate a supersaturated solution.

Storage of Compound

Saturated and supersaturated KCl solutions may be stored at room temperature in a closed container. Due to the extremely high osmotic pressure of the solution, microbial growth is not a concern. The presence of some KCl crystals at the bottom of the storage container is normal.

Use of Compound

KCl should be administered only by an intravenous or intracardiac route in anesthetized animals. A dose of 75-150 mg/kg should be used and the full dose should be administered. Cardiac arrest may occur prior to full administration of the dose. If the full dose is not administered, a secondary physical method must be used to assure death.

Disposal of Compound

Dispose of unwanted KCl as standard waste.

References

Bhatkhande, C.Y. and V.D. Joglekar. Fatal poisoning by potassium in human and rabbit. *Forensic Science Vol. 9*, 1977, pp. 33–36.

K. Watanabe, K. Hasegawa and O. Suzuki. A double-suicide autopsy case of potassium poisoning by intravenous administration of potassium aspartate after intake of some psychopharmaceuticals. *Hum Exp Toxicol* 2011 30: 777

AVMA Guidelines for the Euthanasia of Animals: 2013 Edition

M2.9 POTASSIUM CHLORIDE AND MAGNESIUM SALTS

Although unacceptable when used in conscious vertebrate animals, a solution of potassium chloride, magnesium chloride, or magnesium sulfate injected IV or intracardially in an animal that is unconscious or under general anesthesia is an acceptable way to induce cardiac arrest and death. The potassium ion is cardiotoxic, and rapid IV or intracardiac administration of 1 to 2 mmol/kg (0.5 to 0.9 mmol/lb) of body weight (1 to 2 mEq K⁺/kg; 75 to 150 mg/kg [34.1 to 68.2 mg/lb] of potassium chloride) will cause cardiac arrest.²⁹⁹ This is an injectable technique for euthanasia of livestock or wildlife species that may reduce the risk of toxicosis for predators or scavengers in situations where the remains of euthanized animals may be consumed.^{300,301} Potassium chloride injected IV at 3 mEq/kg (1.4 mEq/lb) into parrots anesthetized with isoflurane caused mild vocalization in 1 of 6 birds and resulted in asystole in 68 seconds.³⁰² Use of 10 mEq/kg (4.5 mEq/lb) IV in anesthetized parrots resulted in involuntary muscle tremors in 5 of 6 birds and caused asystole in 32.8 seconds. Neither dosage resulted in histologic artifacts.

Magnesium salts may also be mixed in water for use as immersion euthanasia agents for some aquatic invertebrates. In these animals, magnesium salts induce death through suppression of neural activity.¹³⁴

Advantages—(1) Potassium chloride and magnesium salts are not controlled substances and are easily acquired, transported, and mixed in the field. (2) Potassium chloride and magnesium salt solutions, when administered after rendering an animal unconscious, result in animal remains that are potentially less toxic for scavengers and predators and may be a good choice in cases where proper disposal of animal remains (e.g., rendering, incineration) is impossible or impractical.

Disadvantages—(1) Rippling of muscle tissue and clonic spasms may occur upon or shortly after injection. (2) Potassium chloride and magnesium salt solutions are not approved by the FDA for use as euthanasia agents. (3) Saturated solutions are required to obtain suitable concentrations for rapid injection into large animals.

General recommendations—Personnel performing this technique must be trained and knowledgeable in anesthetic techniques, and be competent in assessing the level of unconsciousness that is required for administration of potassium chloride and magnesium salt solutions IV. Administration of potassium chloride or magnesium salt solutions IV requires animals to be in a surgical plane of anesthesia characterized by loss of consciousness, loss of reflex muscle response, and loss of response to noxious stimuli. Use in unconscious animals (made recumbent and unresponsive to noxious stimuli) is acceptable in situations where other euthanasia methods are unavailable or not feasible. Although no scavenger toxicoses have been reported with potassium chloride or magnesium salts in combination with a general anesthetic, proper disposal of animal remains should always be attempted to prevent possible toxicosis by consumption of animal remains contaminated with general anesthetics.

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