

Supplementary File 1

(English version)

Medication Protocol: S-ketamine

S-ketamine

Operational Handbook for Ambulance Services → 17 Medication Protocols

Purpose:

To ensure that all prescribing, delegation, dispensing, and administration of medication to patients is unambiguous, accurate, and carried out only by personnel with appropriate training, and to prevent adverse incidents within the applicable areas.

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Ketamine, S-ketamine, pain, fracture, trauma, fentanyl, patient guidance, NMDA

Responsible for:

Medical Lead for Ambulance Services

Standards:

20 Medication-related Procedures

Applies to:

Paramedic

| **Indication** | Pain resulting from significant trauma, fractures of long bones, the spine or pelvis, and dislocations of joints.

For other pain-related conditions, S-ketamine may only be administered following a specific medical prescription by a prehospital physician. |

| **Dosage** | Initial dose is administered according to the table below based on the patient's weight.

Patient weight 30 kg up to 60 kg: 5 mg

Patient weight 60 kg and above: 10 mg

Subsequent doses of 0.125 mg/kg IV / IM may be given at 5-minute intervals if the patient continues to require pain relief. |

| **Route of Administration** | IV administration is preferred, but IM administration is permitted if IV access is not possible. |

| **Form of Administration** | Injection solution, 5 ml ampoule, 5 mg/ml = 25 mg per ampoule. |

| **Side Effects** | Abnormal dreams, nausea, vomiting, transient hypertension, increased salivation, double vision, nystagmus, and allergic reactions. |

| **Interactions** | Opioids prolong the recovery phase. Benzodiazepines may counteract abnormal dreams caused by S-ketamine. Other anaesthetic agents are potentiated and prolonged by S-ketamine. |

| **Documentation** | Treatment must be recorded in the PPJ/ambulance journal, including the dose and time of administration, as well as any side effects.
If additional doses are administered, the initials of the prescribing physician must be included in the journal entry. |

| **Special Considerations** | Fentanyl is the first-line medication for managing pain in patients. It is not a prerequisite to administer fentanyl before S-ketamine in cases of fracture injuries. For pain conditions other than fractures or dislocations, fentanyl should be administered. If fentanyl proves effective, treatment should continue with fentanyl.
If fentanyl is insufficient and the full dose is unlikely to provide further relief, S-ketamine may be considered. If outside the defined indication, a prescription from the prehospital physician is required.

Fentanyl may be administered in a low dose (1–2 micrograms/kg) to counteract discomfort from S-ketamine (e.g., dreams, hallucinations, etc.).

Be aware that the patient may experience respiratory depression from fentanyl if they become pain-free following S-ketamine administration. |

| **Patient Guidance Before S-ketamine Administration:** | The patient must be informed about the medication intended for administration. It should be explained that it is a very potent analgesic.

It is so effective that it may cause some individuals to have vivid dreams, see unusual colours, or even experience hallucinations.

The paramedic should use positive language and create positive expectations before administering S-ketamine, as this reduces the likelihood of negative dreams or hallucinations. The patient must be given the opportunity to decline the medication if they are concerned and prefer to endure the pain or continue with fentanyl treatment.

In cases of severe negative hallucinations or aggressive behaviour, a prehospital physician must be contacted.

Patients who have received S-ketamine must not be transferred via seated patient transport, self-care, self-transport, or similar. The patient must be transported by ambulance. |

| **Antidote** | None |

| **References** | pro.medicin.dk, *The Prehospital Patient*, *Pain Treatment Guidelines*, and *Trauma Treatment Guidelines*. |

| **Pharmacology** | S-ketamine is an NMDA receptor antagonist, with receptors distributed throughout the CNS.

S-ketamine induces dissociative anaesthesia (a trance-like state), due to increased activity in the limbic system and hippocampus.

Complete amnesia may occur following administration. S-ketamine has minor effects on opioid-sensitive receptors. |

| **Pharmacokinetics** | S-ketamine is a synthetic compound.

Onset of action occurs within 30–60 seconds.

Duration of effect is dose-dependent but typically lasts 10–25 minutes for both intravenous and intramuscular administration.

S-ketamine is metabolised in the liver.

T_{1/2}: 79–186 minutes |

Supplementary File 2

ePMR questionnaire:

1. Patient weight
2. Would you (the patient) want to receive S-ketamine again in a similar situation?
(Yes, No, Unsure)
3. Did you (the patient) experience satisfactory alleviation of pain? (Yes, No)
4. Did you (the patient) experience any side effects? (Yes, No)
5. Did you (the patient) experience diplopia or blurred vision? (Yes, No)
6. Did you (the patient) experience positive hallucinations? (Yes, No)
7. Did you (the patient) experience negative hallucinations? (Yes, No)
8. Did the heart rate change in heart rate of more than +/- 20bpm? (Yes, No)
9. Did the non-invasive blood pressure change more than +/- 20mmHg? (Yes, No)
10. How many doses of S-ketamine were required for effect? (1, 2, 3 or more, no effect at all)
11. Did the paramedic assess that the patient had sufficient pain relief? (Yes, No)

Supplementary File 3

Automated search parameters for validation of data.

Done twice a week during the investigation.

Any instance of S-ketamine given, recorded in the medicine chart of the ePMR (called PPJ in Danish).

Any part of the S-ketamine questionnaire filled out.

The generated results consisted of the following parameters:

- PPJ journal ID (for follow-up in the medical chart)
- Chart creation time
- S-ketamine project questionnaire
- User responsible for registration of project data
- Title of user responsible for registering project data
- Doses of S-ketamine given as recorded in the medical chart
- User registration of s-ketamine in ePMR (PPJ)
- Title of user who has registered the use of S-ketamine in the medical chart
- NRS score
- Ambulance ID