Medication Formulary and EMS Usage Assignment (Example)

Purpose: This assignment is designed to solidify principle pharmacologic concepts and apply them to the EMS Profession.

Instructions: For this assignment choose **ONE** medication that is not used in your current or last EMS Service from the categories of medications listed below that you believe would be useful for EMS to utilize. Complete the below worksheet using academic writing and grammatical standards, with complete sentences and well-developed ideas and concepts. Your answers should provide enough information to convey your message while remaining succinct and to the point.

Assignment #1 Medication Classes

- Medications affecting the Sympathetic or Parasympathetic Nervous System
- Medications affecting the Autonomic Ganglia
- Muscle Relaxants
- Local Anesthetics
- Sedative/Hypnotic Medications
- Antidepressants
- Psychomotor Stimulants
- Psychotomimetic Medications

Assignment #2 Medication Classes

- Antiepileptic Medications
- General Anesthetics
- Opioid Analgesics
- Non-Opioid Analgesics, and NSAIDs
- Anti-Dysrhythmic and Anti-Anginal Medications
- Diuretics, Antihypertensive, Anticoagulants and Hyperlipidemia Medications
- Antihistaminic and Mast Cell Inhibitor Medications

Assignment #3 Medication Classes

- Respiratory Medications
- Gastrointestinal Medications
- Medications affecting the Thyroid, Parathyroid, Pancreas, Pituitary or Adrenal Gland
- Antibacterial Medications
- Antifungal, Antiviral, or Antiprotozoal Medications

Medication Formulary and EMS Usage Assignment (Example)

Medication Name(s): Ketamine Hydrochloride Injection USP

Pharmacological Classification: Parenteral General Anesthetic

Indications and Clinical Usage:

1. As the sole anesthetic agent for recommended diagnostic and surgical procedures. Although best suited to short procedures, Ketamine Hydrochloride Injection USP can be used, with additional doses, for longer procedures. NOTE: If skeletal muscle relaxation is desired, a muscle relaxant should be used. In surgical procedures involving visceral pain pathways, Ketamine Hydrochloride Injection USP should be supplemented with an agent that obtunds visceral pain.

2. For the induction of anesthesia prior to the administration of other general anesthetic agents.

3. To supplement low potency agents such as nitrous oxide.

Recommended Indications and Clinical Usage for EMS

1. Clinical Anesthetic and Induction Agent
2. Chemical Restraint

Specific Procedures/Protocols for use

1. Behavioral/Chemical Restraint
2. Advanced Airway Management
3. Rapid Sequence Induction/Drug Facilitated Intubation
4. Pain Management

Absolute Contraindications

1. The drug is contraindicated in persons with a history of cerebrovascular accident.
2. It is contraindicated in those in whom a significant elevation of blood pressure would constitute a serious hazard, such as patients with significant hypertension.
3. It is contraindicated in persons with severe cardiac decompensation.
4. It is contraindicated in surgery of the pharynx, larynx, or bronchial tree unless adequate muscle relaxants are used.
5. It is contraindicated in those showing hypersensitivity to the drug

Medication Considerations

1. Ketamine Hydrochloride Injection USP should only be used after careful consideration of the benefit/risk assessment.
2. Cardiac function should be continually monitored during the procedure in patients found to have hypertension or cardiac decompensation.
3. Barbiturates and Ketamine Hydrochloride Injection USP, being chemically incompatible because of precipitate formation, should not be injected from the same syringe.
4. Barbiturates and narcotics, being central nervous system depressants, may prolong recovery time if used concurrently with Ketamine Hydrochloride Injection USP.

5. Postoperative confusional states may occur during the recovery period (see item 6 under Precautions).
6. Respiratory depression may occur with overdosage or too rapid administration of Ketamine Hydrochloride Injection USP, in which case supportive ventilation should be employed. Mechanical support of respiration is preferred to administration of analeptics.
7. Precautions should be used in patients with upper respiratory infection because of the increased danger of respiratory difficulties, such as laryngospasm, in these cases.
8. Resuscitative equipment should be available and ready for use.
9. The initial intravenous dose should be administered over a period of 60 seconds. More rapid administration may result in respiratory depression and enhanced pressor response.

.

Reaction	Number	Percent	Percent in 15 to 35 Yrs. Age Group
Dreams, Pleasant or Not Specified	679	5.44	9.6
Dreams, Unpleasant	199	1.62	3.1
Hallucinations	152	1.23	1.6
Confusion, With and Without Vocalization	327	2.66	4.7
Excitement or Irrational Behaviour	111	0.89	1.8
Psychic Abnormalities	62	0.51	0.8
Overall Rate*		11.0	19.4

*Some procedures have multiple emergence reactions, therefore the overall rate is less than the sum of the reactions.

Medication Effects

Ketamine Hydrochloride Injection USP is a rapid-acting, non-barbiturate general anesthetic. It produces an anesthetic state characterized by profound analgesia, normal pharyngeal-laryngeal reflexes and normal or slightly enhanced skeletal muscle tone. Mild cardiac stimulation and occasionally respiratory depression occur.

The anesthetic state produced by Ketamine Hydrochloride Injection USP has been termed “dissociative anesthesia” in that it appears to selectively interrupt association pathways of the brain before producing somesthetic sensory blockage. Ketamine Hydrochloride Injection USP decreases the activity of the neocortex and subcortical structures (thalamus) and increases the activity in the limbic system and reticular substance.

Following administration of recommended doses of Ketamine Hydrochloride Injection USP, blood pressure and pulse rate are usually moderately and temporarily increased. In 12,283 procedures, the median systolic rise was 24% and the median diastolic rise was 22%. Ketamine Hydrochloride Injection USP Page 3 of 14

Respiration is usually unaffected. Mild stimulation occasionally occurs. However, transient respiratory depression (rate and tidal volume) may occur and is generally associated with rapid (less than 60 seconds) intravenous administration. Blood gas tensions (PO2 and PCO2) are relatively unaffected.

A patent airway is maintained partly by virtue of unimpaired pharyngeal and laryngeal reflexes.

Medication Formulary and EMS Usage Assignment (Example)

Medication Side Effects and Adverse Reactions

1. One of the most characteristic physiologic effects of Ketamine Hydrochloride Injection USP is temporary augmentation of the pulse rate and blood pressure. Elevation of blood pressure begins shortly after injection, reaches a maximum within a few minutes, and usually returns to preanesthetic values within 15 minutes of injection. The median peak rise has ranged from 20 to 25% of preanesthetic values for both systolic and diastolic readings. Depending on the condition of the patient, this elevation of blood pressure may be considered a beneficial effect, or in others, an adverse reaction. If elevation of blood pressure would be considered adverse to the patient, the benefit to risk ratio should be carefully determined. Maintaining or moderately increasing blood pressure may be beneficial to some patients, as those in shock or those in whom reduction in blood pressure is contraindicated.
2. Hypotension, arrhythmias, and bradycardia have been occasionally observed.
3. Although respiration is frequently stimulated, severe depression of respiration or apnea may occur following rapid intravenous administration of high doses of ketamine. Respiratory depression, mild or moderate and transient, occurred in a small percentage of patients with normal doses. In the majority of these patients, it is not a serious problem. Laryngospasm and other forms of airway obstruction have occurred during Ketamine Hydrochloride Injection anesthesia.
4. Increased salivation may occur unless an antisialagogue is used.
5. In some patients, enhanced skeletal muscle tone may be manifested by tonic and clonic movements, sometimes resembling seizures. These movements do not imply a light plane and are not indicative of the need for additional doses of the anesthetic.
6. EEG recordings were made in 14 patients receiving Ketamine Hydrochloride Injection. Although one of these patients exhibited slight twitching of the arms and legs, none showed EEG changes to suggest seizure reactions. Epileptiform attacks have been observed in a few patients following Ketamine Hydrochloride Injection administration. However, Ketamine Hydrochloride Injection has been used successfully in patients known to be suffering from epilepsy.
7. Blurred vision, nystagmus and diplopia are not uncommon findings during the recovery period.
8. Anorexia, nausea or vomiting are minimal, allowing the great majority of patients to take liquids by mouth shortly after regaining consciousness.
9. Except for occasional reports of local pain and exanthema at the injection site, Ketamine Hydrochloride Injection is well tolerated by the patient when administered either by the intravenous or intramuscular route. Transient erythema, morbilliform rash and anaphylaxis and have been reported.
10. Ketamine Hydrochloride Injection causes a small transient increase in intraocular pressure. However, it has been used in patients with glaucoma without causing any deterioration in this condition.
11. Severe irritative and inflammatory urinary tract and bladder symptoms including cystitis have been reported in individuals with history of chronic ketamine use or abuse. Cases of damage to and/or destruction of the urinary tract have also been reported in this population.

Medication Formulary and EMS Usage Assignment (Example)

Use in Pregnancy

1. The safe use in pregnancy has not been established, and such use is not recommended.

Use in Pediatrics

1. Animal studies show that ketamine is associated with significant neuronal loss in the developing brain. Because of the lack of information on pediatric safety, the risks of ketamine use in the pediatric population must be carefully considered against its potential benefits.

Pharmacology

1. Ketamine Hydrochloride Injection is a cataleptic, analgesic and anesthetic agent devoid of sedative or hypnotic properties, distinguishing it from the commonly used barbiturates. The depth of analgesia and anesthesia induced by Ketamine Hydrochloride Injection varies with the animal species, being more pronounced in monkeys, cats, rats and mice than in pigeons, guinea pigs, dogs and rabbits.
2. Metabolism: Ketamine Hydrochloride Injection USP is rapidly absorbed following parenteral administration. Animal experiments indicated that Ketamine Hydrochloride Injection was rapidly distributed into body tissues, with relatively high concentrations appearing in body fat, liver, lung and brain; lower concentration were found in the heart, skeletal muscle and blood plasma. Placental transfer of the drug was found to occur in pregnant dogs and monkeys. No significant degree of blinding to serum albumin was found with Ketamine Hydrochloride Injection.
3. Balance studies in rats, dogs, and monkeys resulting in the recovery of 85 to 95% of the dose in the urine, mainly in the form of degradation products. Small amounts of drug were also excreted in the bile and feces. Balance studies with tritium-labelled Ketamine Hydrochloride Injection in human subjects (1 mg/lb given intravenously) resulted in the mean recovery of 91% of the dose in the urine and 3% in the feces. Peak plasma levels averaged about 0.75 mcg/mL, and CSF levels were about 0.2 mcg/mL, one hour after dosing.
4. Ketamine Hydrochloride Injection undergoes N-demethylation and hydroxylation of the cyclohexanone ring, with the formation of water-soluble conjugates which are excreted in the urine. Further oxidation also occurs with formation of a cyclohexanone derivative. The unconjugated N-demethylated metabolite was found to be less than one-sixth as potent as Ketamine Hydrochloride Injection. The unconjugated Ketamine Hydrochloride Injection USP Page 10 of 14 demethyl cyclohexanone derivative was found to be less than one-tenth as potent as Ketamine Hydrochloride Injection. Repeated doses of Ketamine Hydrochloride Injection administered to animals did not produce any detectable increase in microsomal enzyme activity.
5. Doses of 0.5 to 2.0 mg/kg of Ketamine Hydrochloride Injection produce consistent and marked changes of EEG in man. The abolition of alpha waves and induction of theta activity were the most typical effects of Ketamine Hydrochloride Injection.
6. **Onset and Duration:** Because of rapid induction following the initial intravenous injection, the patient should be in a supported position during administration. The onset of action of Ketamine Hydrochloride Injection USP is rapid; an intravenous dose of 1 mg/lb (2 mg/kg) of body weight usually produces surgical anesthesia within 30 seconds after injection, with the

anesthetic effect usually lasting five to ten minutes. If a longer effect is desired, additional increments can be administered intravenously or intramuscularly to maintain anesthesia without producing significant cumulative effects. Intramuscular doses, from experience primarily in children, in a range of 4 to 6 mg/lb (9 to 13 mg/kg) usually produce surgical anesthesia within three to four minutes following injection, with the anesthetic effect usually lasting 12 to 25 minutes.

Abuse and Dependency

1. Ketamine has been reported as being used as a drug of abuse. Reports suggest that ketamine produces a variety of symptoms including, but not limited to, flashbacks, hallucinations, dysphoria, anxiety, insomnia, or disorientation. Ketamine dependence and tolerance may develop in individuals with a history of drug abuse or dependence. A withdrawal syndrome with psychotic features has been described following discontinuation of long-term ketamine use.

Toxicology

1. **Acute Toxicity:** The intraperitoneal LD50 values were 275 mg/kg in neonatal mice, 209 mg/kg in preweaning mice, and 224 mg/kg in adult mice. In rats, the intraperitoneal LD50 values were 146 mg/kg for the neonates, 170 mg/kg for the preweaning groups, and 224 mg/kg for adult rats.
2. **Chronic Toxicity:** Rats given daily I.V. injections of 2.5 to 10 mg/kg of Ketamine Hydrochloride Injection for six weeks had only slight food intake depression and moderate weight gain depression, which was dose related in males but not in females. Regular monitoring of laboratory data and final autopsy studies failed to demonstrate drug-related toxic effects. Weight loss in dogs given daily I.M. injections of Ketamine Hydrochloride Injection up to 40 mg/kg for six weeks presumably was due to general depression of physical activity produced by the drug. There were no consistent hematologic or hematopoietic alterations. There were elevations in serum cholesterol, urea, alkaline phosphatase and transaminase values which were most prominent in animals receiving high doses. These values returned to normal levels at the termination of the dosing period. These altered values may be associated with temporary anorexia and weight loss. Histologic changes were not significant. When monkeys were anesthetized for three to six hours, twice weekly for four to six weeks, there were minor elevations in the sedimentation rate and variable changes in the total leukocyte and neutrophil differential values.

EMS Specific Dosage and Use Recommendations

1. Chemical Restrain: 300 – 400mg IM/IV/IO
2. Drug Assisted Intubation: 1.5 – 2mg/kg IM/IV/IO
3. Post Intubation Sedation: .5 – 1 mg/kg IM/IV/IO
4. Pain Management 1 - 2 mg/kg IM/IV/IO

Medication Formulary and EMS Usage Assignment (Example)

References

North Carolina Office of Emergency Medical Services (n.d.) Drug List. Retrieved from: https://www.ncems.org/nccepstandards/druglists/druglistsAandB.pdf

Sterimax Inc. (2017). Prescribing Information Ketamine Hydrochloride Injection USP. Retrieved from: https://pdf.hres.ca/dpd_pm/00042733.PDF

South Carolina Department of Health and Environmental Control, Bureau of EMS (2016) South Carolina EMS Protocols. Retrieved from: https://www.scemsportal.org/sites/default/files/2016CompleteSouthCarolinaProtocolsDraft.pdf