PARENTERAL KETAMINE INFUSION - SCH

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- Ketamine may be used for procedural sedation in the Emergency Department. Please refer to the Procedural Sedation in the Emergency Department Practice Guideline.
- ENs must follow Enrolled Nurse (EN): Scope of Practice Policy.
- The key to the PCA machine is to be stored with the Schedule 8 drug key
- Intravenous/Subcutaneous ketamine infusions may be prescribed by medical staff in consultation with a member of the Acute Pain Service/ Anaesthetic Department /Intensive Care Unit Medical Officer/Palliative Care//Senior Oncologist/ Emergency Department Specialist.
- Ketamine infusions are delivered using the (B.Braun) Perfusor© Space Syringe Pump PCA Pump, *with the exception* of the Children's Intensive Care Unit (CICU). A programming guide is found in the Appendix of this document
- CICU medical staff can prescribe ketamine infusions for their own patients, and will refer to APS when ready for discharge to ward areas.
- All vital signs, pain and sedation observations must be documented hourly in electronic Between The Flags (eBTF) chart and the patient must be monitored on continuous pulse oximetry
- Administration observations (i.e. rate administered and cumulative doses) must be made on the Multi-modal Analgesia Infusion Record.
- Only those Registered Nurses who have read this guideline and are aware of the pharmacology, use and administration of ketamine may care for patients receiving a ketamine infusion. Staff must complete ward-based competency assessment with their Clinical Nurse Educator (CNE)
- Registered Nurses must also be assessed and competent in drug calculation and intravenous drug administration.
- Ketamine has a limited compatibility profile, therefore, in some cases, ketamine infusions may need to be administered subcutaneously.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
Date Effective:	1st March 2022	**Review Period**: 3 years
Team Leader:	CNC	**Area/Dept**: Pain Team SCH

CHANGE SUMMARY

- Clarification around use of ketamine in children under 3 months of age
- Clarification of CICU dosing
- Line change to be performed every 96 hours, in line with NSW Health Intravascular Access Devices (IVAD) – Infection Prevention and Control Policy Directive
- **28/11/23** – minor review to correct the title.

READ ACKNOWLEDGEMENT

- All Clinical Nurses and Medical Officers must read and notify their local manager that they understand the content of the document.
- Registered Nurses must be assessed competent in drug calculation and intravenous drug administration prior to administer ketamine.

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1 Standard

- Intravenous/subcutaneous ketamine infusions may be prescribed by medical staff in consultation with:
  - a member of the Acute Pain Service/ Anaesthetic Department, OR
  - Intensive Care Unit Medical Officer, OR
  - Palliative Care, Senior Oncologist, OR
  - Emergency Department Staff Specialist.
- Ensure placeholder documented in Medication Administration Record (MAR)
- Outside of CICU, all Intravenous/Sub-Cutaneous ketamine infusion prescription orders must be made using the Paediatric Parenteral Analgesia Prescription form.
  - For guidance on CICU administration of ketamine, see Section 7 Ketamine infusions within Children's Intensive Care Unit (CICU)

Administration

- PCA pumps utilised at SCH are B. Braun smart infusion pumps
- Ketamine infusions are delivered using the PCA Pump. A programming guide is found in the APPENDIX of this document
- As ketamine may be used in conjunction with an opioid infusion, naloxone must be available on the ward.
- Ketamine has a limited compatibility profile, therefore in some case such as limited IV access, ketamine infusions may need to be administered subcutaneously.

Documentation

- All vital signs, pain and sedation observations must be documented hourly in eBTF and the patient must be monitored on continuous pulse oximetry
- Administration observations (i.e. rate administered and cumulative doses) must be made on the Multi-modal Analgesia Infusion Record.

Training

- Only those Registered Nurses who have read this guideline and are aware of the pharmacology, use and administration of ketamine may care for patients receiving a ketamine infusion. Staff must complete ward-based competency assessment with their Clinical Nurse Educator (CNE)
- Registered Nurses must also be assessed and competent in drug calculation and intravenous drug administration

Outcomes

- Parenteral ketamine infusions are administered in a safe, effective manner.
- Patient achieves an optimal level of analgesia.

2 Introduction

Ketamine is a rapid acting anaesthetic agent used for induction and maintenance of anaesthesia and as an intravenous analgesic/sedative. It has potent analgesic properties and produces dissociative anaesthesia in high doses. This dissociative state is characterised by profound analgesia and amnesia, often with the retention of protective airway reflexes and independent respirations. A patient's eyes may remain open and the corneal and light reflexes may remain intact. The body may develop a hypertonic state with occasional spontaneous movements. Patients may awake slowly and with emergence phenomena such as agitation and hallucinations.

When ketamine is used in sub-anaesthetic doses by the subcutaneous or intravenous route, it may assist in controlling acute or chronic pain. Ketamine is a non-competitive antagonist at the NMDA receptor, preventing binding of the excitatory amino acid glutamate. It seems to be particularly useful for severe pain, which is not well controlled by other agents 4, 6, 7. It is also useful for patients who are tolerant to opioids, or to reduce opioid doses in order to minimise adverse effects of opioids[4, 6, 7].

Ketamine has no reversal agent.

2.1 Pharmacokinetics[12, 13]

- After IV injection, onset of action is rapid (within 1 minute). This anaesthetic effect will last for 5 - 10 minutes. Recovery is within approximately 15 - 20 minutes.
- After commencement of an infusion for analgesic purposes, onset is more delayed (approximately 30-60 minutes).
- IM injection acts within 3 - 4 minutes and the effect lasts 12 - 25 minutes, when used in an anaesthetic setting.

Ketamine is rapidly absorbed following parenteral administration and has a plasma half-life in the range of 2 - 4 hours. Following administration ketamine is rapidly and extensively distributed throughout the body into highly perfused tissues, including the brain. It is then redistributed from the central nervous system to peripheral tissues resulting in a short-lived therapeutic effect.

Ketamine undergoes extensive hepatic metabolism to the active metabolite nor-ketamine, with approximately 90% of ketamine excreted in the urine, mostly as metabolites. Children metabolize ketamine more rapidly than adults. [13]

Plasma half-life, clearance and volume of distribution (relative to body weight) are not significantly different between adults and children.

2.2 Contraindications[12, 13]

- Contraindicated in patients with:
- increased intracranial pressure
- cerebral trauma, Central Nervous System lesions/tumours, hydrocephalus,
- conditions where a significant elevation of blood pressure is hazardous e.g., hypertension

- eye injuries or raised intraocular pressure
- Use with caution in patients with a history of seizures or cases of known pulmonary hypertension
- There is limited evidence for the use of ketamine infusions in infants < 3 months of age ketamine should be avoided for children aged under 3 months of age unless absolutely necessary and at the discretion of a consultant from Anaesthesia, Pain, Palliative Care or Intensive Care and then used for as short a time as possible to a maximum of 200 microg/kg/hr.

2.3 Adverse Reactions[12]

Cardiovascular: Blood pressure and pulse rate are frequently elevated following high dose administration of ketamine. However, hypotension, bradycardia and arrhythmias have been observed. Low dose ketamine causes minimal changes in heart rate and blood pressure.

Respiratory: Although respiration is frequently stimulated, severe depression of respiration or apnoea may occur following rapid intravenous administration of high doses of ketamine.

Eye: Diplopia and nystagmus have been noted following administration of ketamine and there may be an increase in intraocular pressure.

Psychological: Emergence reactions have been noted. The manifestations vary in severity between pleasant dream like states, vivid imagery, hallucinations and emergence delirium. This can be accompanied by confusion, excitement or irrational behaviour. The duration lasts no more than a few hours; although in a few cases, recurrences have taken place up to 24 hours post-operatively. This emergence phenomena is less frequent in those aged 15 years and under. These reactions may be reduced if verbal, tactile and visual stimulation of the patient is minimised during the recovery period. In low doses, severe reactions are unlikely – possible hyperacuity, sensitivity to light and sound and vivid dreams may be seen. Use of benzodiazepines may decrease chance of emergence reactions, however, concurrent benzodiazepine use may prolong the half-life of ketamine and increase sedative effects.

Neurological: In some patients, enhanced skeletal muscle tone may be manifested by tonic/clonic movements, jerking, which may resemble seizures.

Gastrointestinal: Anorexia, nausea and vomiting.

General: Hypersalivation and increased lacrimation have been reported in a significant number of patients, usually with higher doses. Anticholinergics (e.g. glycopyrrolate, atropine) are often used concurrently to counter this effect.

Local pain, irritation and erythema can occur at intravenous and subcutaneous injection site. Ketamine is irritating to small veins.

3 Administration

- Low dose ketamine infusions have been shown to aid post-operative analgesia when used alone or in conjunction with opioid infusions 4, 6
- When used in conjunction with an opioid infusion, opioid consumption may then be reduced by up to 50%. This may also reduce the incidence of opioid related side effects.[4, 6]
- Some patients in special situations may require doses in excess of those normally required e.g. Oncology or palliative care patients.
- Intravenous ketamine infusions are administered as a sideline infusion via the PCA pump in general wards and ED; a *syringe driver may only be used in CICU*
- Subcutaneous ketamine infusions are given via a subcutaneous cannula via the PCA pump
- The syringe must be clearly labelled as per Labelling of Injectable Medicines, Fluids and Lines policy[2] and changed every 24 hours
- The line delivering ketamine to the patient must be clearly labelled and changed every 96 hours. This is in line with NSW Health Intravascular Access Devices (IVAD) – Infection Prevention and Control.
- Do not commence a ketamine infusion if the child is heavily sedated or difficult to rouse
  - If sedation score is in the BLUE zone of the MPC
    - Continue to monitor patient regularly
  - If sedation scores in YELLOW or RED zone of the MPC
    - Follow local procedures as per SPOC
- Ketamine is dose responsive, i.e. side effects may be minimised by reducing dose
- Ketamine is compatible with blood products[9, 10] opioids and standard IV fluids.
- In exceptional circumstances, ketamine may be added to a PCA or Opioid syringe. Typically 1mg ketamine to 1mg morphine, however this dose may need to be adjusted as required – If required please consult with Pain or Palliative Care Teams
- All syringes loaded must be recorded and signed by two Registered Nurses on page 3 of the prescription form and in the **SCHEDULED DRUG REGISTER**.

3.1 Standard Orders

1. An anti-reflux anti siphon PCA administration set is to be used for all intravenous ketamine infusions.
2. Subcutaneous infusions should be administered using a single intravenous administration set without any additional access ports
3. If ketamine is used in conjunction with an opioid infusion, naloxone must be prescribed, available and given as required (as per SCH Opioid Management Guideline).
4. A sideline infusion of a maintenance fluid running at a minimum of To Keep Vein Open (TKVO) is required for IV administration

Note: Naloxone will not reverse any side effects associated with ketamine.

4 Prescribing

- Intravenous/subcutaneous ketamine infusions may be prescribed by medical staff in consultation with:
  - a member of the Acute Pain Service/ Anaesthetic Department, OR
  - Intensive Care Unit Medical Officer, OR
  - Palliative Care, Senior Oncologist, OR
  - Emergency Department Staff Specialist.
- For children aged under 3 months of age, ketamine should be avoided unless absolutely necessary and at the discretion of a consultant from Anaesthesia, Pain, Palliative Care or Intensive Care.
- All Intravenous/Sub-Cutaneous ketamine infusion prescription orders must be made using the Paediatric Parenteral Analgesia Prescription form.

The prescriber must:

- Place patient label on Paediatric Parenteral Analgesia Prescription form and sign across label, if ID label unavailable written patient details must be completed
- Select appropriate ketamine protocol according to patient weight, complete the pump programming prescription as per the standard table –see Section 6 or page 2 of the prescription form
- Recommended starting rate for patient weight ≥ 20kg is 100 microg/kg/hr which can then be titrated to effect
- Sign and date prescription

4.1 Standard Prescription

Patient Weight	Protocol Name	Amount/50mL	Concentration	Infusion Rate (range)	Usual starting rate
0-20kg	ketamine-INF_0-20kg	200 mg/50 mL	4 mg/mL	0-200 microg/kg/hr	50 microg/kg/hr
20-50kg	ketamine-INF_20-50kg	400 mg /50 mL	8 mg/mL	0-400 microg/kg/hr	100 microg/kg/hr
>50kg	ketamine-INF_>50kg	600 mg/50 mL	12 mg/mL	0-400 microg/kg/hr	100 microg/kg/hr

5 Monitoring

- Continuous Pulse Oximetry is required for all patients receiving ketamine
- All vital signs, pain and sedation observations must be documented in eBTF as per SCHN policy
- Administration observations (i.e. rate administered and cumulative doses) must be made on the Multi-modal Analgesia Infusion Record http://intranet.schn.health.nsw.gov.au/files/attachments/2183/scn130325.pdf
- Patient monitoring and documentation as follows:
    - Respiratory rate
    - Oxygen saturations
    - Heart rate
    - Pain score (appropriate for age/cognition)
    - Sedation Score
    - Rate of Infusion/Progressive total/Demands
    - Temperature and Blood Pressure 4/24

    } Every Hour for the duration of the infusion

6 Preparation

6.1 Commencing Infusion

- A 50mL luer-lock syringe must be loaded and checked independently by two RN's or RN & EN following prescription on the Paediatric Parenteral Analgesia Prescription form and recorded in Schedule 8 Drug Register.
- PCA administration set with anti-reflux and anti-siphon valve is primed and clamp on IV line is closed.
- Lines and syringes must be labelled as per SCH guidelines
- Obtain PCR pump lock box key and open lock box
- Load the syringe with primed administration set attached, into the PCA pump and close lock box
- Select protocol as per prescription
- Enter patient weight
- Pump program must then be checked by two RNs or RN & EN prior to attaching giving set to patient
- Prescription is rechecked by two RN's or RN & EN against patient ID band and administration set is then attached to IV access

- Release all line clamps and press start to commence infusion
- Document new syringe in “Record of Opioid PCA/NCA/Infusion syringe administration and drug discarded” area of the Paediatric Parenteral Analgesia Prescription form
- See APPENDIX for step by step guides to
  - programming pump
  - altering a program
  - syringe change
  - shutting down the pump

7 Ketamine infusions within Children’s Intensive Care Unit (CICU)

7.1 Standard CICU Prescription

- For patients in CICU the continuous ketamine infusion must be prescribed on the Paediatric Prescription for Continuous Opioid/Ketamine infusion chart (SEI130.320) by CICU medical staff, APS or Anaesthesia staff
- Ensure that the following are completed for a valid prescription:
  - Patient identification
  - Weight
  - Allergies

Drug	Dose in 50mL	Infusion Rate (dose/kg/hour)	Bolus Dose	Fluid
Ketamine	5 mg/kg in 50mL (max 600 mg in 50mL)	0 - 500 microg/kg/hr	Not recommended	0.9% sodium chloride

7.2 Preparing and Programming

- Only Registered Nurses (RN) who have been assessed as competent in Administration of Intravenous Medications and Fluids to Paediatric Patients and who have successfully completed the HETI Fundamentals of Paediatric Medication Safety Module, may prepare, check, and care for patients receiving parenteral ketamine in CICU
- The ketamine infusion must be prepared by two RN’s following a valid prescription.
- The prescribed dose must be checked prior to preparation.
- The syringe and lines are to be labelled as per the National Standard for User Applied Labelling of Injectable Medicines, Fluids and Lines.
- The prepared syringe is to be loaded into the syringe driver and programmed using the CICU profile drug library software.

- Prior to connection to the patient, the prescription, pump program and patient ID are checked by two RN's. Special attention must be made to ensure the pump is programmed with the correct patient weight, dose and volume.
- The rate (in mL/hr) at which the infusion needs to run MUST also be calculated and checked against the programmed infusion.
- The infusion can then be connected and commenced.
- Ketamine is not routinely bolused but may be administered under the supervision of a CICU senior medical officer or anaesthetist only

7.3 Monitoring

- Observations must attended as per the Clinical Observations in CICU - SCH Practice Guideline

7.4 Prior to transfer to the Ward

- Ensure an APS referral is completed and they are notified of the discharge of a patient with a ketamine infusion from CICU
- Ketamine infusions must be prescribed, prepared and programmed as per Section 3, 4 and 6 of this guideline using the Paediatric Parenteral Analgesia Prescription form
- A PCA pump must be used for all ketamine infusions for any patient transferring to the ward
- In hours obtain a (B. Braun) PCA pump from Paediatric Recovery
- Out of hours contact the after-hours supervisor for access to Recovery
- Change infusion with two RN's ensuring that the syringe and lines are labelled as per the National Standard of User Applied Labelling of Injectable Medicines, Fluids and Lines
- A "PCA" administration set with an anti-reflux and anti-siphon valve must be used.
- Two RN's must check the prescription, patient's ID and programming of the pump prior to commencing the infusion
- Observe for complications following change to the PCA pump and protocol
    - See Adverse Reactions section
- Ensure sedation and pain score are charted with discharge observations on eMR Between the Flags chart
- Administration observations (i.e. rate administered and cumulative doses) must be made on the Multi-modal Analgesia Infusion Record.

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APPENDIX: Using the (B. Braun) PCA pump

1. Programming the PCA pump

- Make up syringe as per the prescription and connect and prime the giving set
- Using Lock-Box key open the front of the lock box
- Press Green Power key
  - The pump will open plunger arm
- Pull down front cover
- Pull out Syringe holder fully and rotate 90° to the right
  - This will open the green syringe flange holder
- Slide syringe into pump with graduation markings on the bottom, then rotate so graduations are facing forward
  - Ensure syringes flange is located in green holder
- Holding syringe in place with left hand, pull back on syringe holder and rotate to the left and ease forward to locate syringe
  - Plunger will then be locked in place
- Close front cover and using navigation keys select syringe type
  - Press left arrow key to select
- Plunger arm will then locate the end of the syringe
- Close lock the Lock-Box
- Screen should say “New Therapy” and have the option to “Use drug library”
  - If this screen is not displayed the pump may not have been shut down correctly from previous patient
  - Press green C key and screen displays “Use last therapy?” use down arrow to select No
- Use up arrow to select Yes to use drug library
- Use down arrow until “Change care unit” is highlighted then press Left arrow to select
- Use up/down arrow keys to highlight “Standard” then Left arrow to select
- Use up/down arrow keys to highlight delivery mode as per prescription and press left arrow to select
- Use up/down arrow keys to highlight protocol and left arrow to select
- Enter patient weight using arrow keys then press OK to confirm
  - Weight option is not active for any protocols where the patient weight is > 50 kg
- Use up/down arrow keys to scroll through settings and check against prescription
  - This is a 2 nurse check
- Edit the program if required by using up/down arrow keys to highlight parameter then press left key
- Enter pass code using arrow keys and OK
- Use arrow keys to alter parameter then press OK

- Once happy program is correct, check prescription ID against patient ID band and connect giving set to patients IV access device
- If pump is set up in recovery, the pump can be put into standby mode pressing and holding green power key for 3 seconds
  - Cancel standby by pressing C key and entering pass code
- Release any clamps on the line
- Press start/stop key
- Enter pass code using arrow keys and OK
- Pump is now running
  - If there is a background infusion the 4 arrows on the display will indicate the infusion is running

2. Altering a program on the PCA pump

- Press green C key
- Use up/down arrow keys to highlight parameter then press left key
- Enter pass code using arrow keys and OK
- Use arrow keys to alter parameter then press OK
- Pump remains running throughout this process
- Pump will lock screen after a few seconds
- Document Change on Multi Modal Analgesia Observation Form and in patient's eMR

3. Syringe change procedure

- Prepare new Syringe as per Prescription
- Press start/stop key
- Enter pass code using arrow keys and OK
- Clamp all lines
- Unlock the "Lock-Box"
- Briefly pull back on Syringe Holder and release
- Screen will then display "Syringe change"
- Select Yes using up arrow
- Plunger arm will then open
- Pull down front panel
- Pull out Syringe holder fully and rotate 90° to the right
  - This will open the green syringe flange holder
- Remove old syringe from pump
  - Swap new syringe onto giving set
- Slide new syringe into pump with graduation markings on the bottom, then rotate so graduations are facing forward

  - Ensure syringes flange is located in green holder
- Close front cover and using navigation keys select syringe type
  - Press left arrow key to select
- Plunger arm will then locate the end of the syringe
- Close lock the Lock-Box
- Press start/stop key
- Enter pass code using arrow keys and OK
- Pump is now running
  - If there is a background infusion the 4 arrows on the display will indicate the infusion is running

4. Shutting down the PCA pump at the end of use

- Press start/stop key
- Enter pass code using arrow keys and OK
- Clamp all lines
- Unlock the “Lock-Box”
- Briefly pull back on Syringe Holder and release
- Screen will then display “Syringe change”
- Select Yes using up arrow
- Plunger arm will then open
- Pull down front panel
- Pull out Syringe holder fully and rotate 90° to the right
  - This will open the green syringe flange holder
- Remove old syringe from pump
- Close syringe holder and front panel
- Press and hold green power key for 3 seconds and pump will close plunger arm and shut down