SOP for the Prescribing and Administration of Milrinone on The Children's Heart Centre	
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Should be read in conjunction with:	SOP for the Preparation of Standard Concentration Infusions & the use of Drug Library and Smart Pumps in CHC
Location of Copies	On Hospital Intranet and locally in department

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Introduction:

Milrinone is a phosphodiesterase type-3 inhibitor with positive inotropic and vasodilator properties. It exerts most of its effect on the myocardium. Administration of Milrinone results in an increase in cardiac output, stroke volume, decreased intra-cardiac filling pressure, and decreased systemic resistance with no significant change in heart rate or myocardial oxygen consumption. [1, 2]

Indications for use:

- Treatment of congestive heart failure
- Treatment of low cardiac output states following cardiac surgery
- Treatment of cardiomyopathy

Specific Considerations:

The decision to commence milrinone in a cardiac patient is to be taken at consultant level.
The Children's Heart Centre will accept haemodynamically stable children from PICU currently receiving a continuous infusion of milrinone for doses of 0.5micrograms/kg/min or less. Milrinone may be commenced at ward level in the event of a rapidly deteriorating clinical situation if directed by a Consultant Cardiologist or Intensivist, once a PICU bed is booked and available. Milrinone can be recommenced on a patient who has received a milrinone infusion in the previous 48 hours. Any dose above 0.5micrograms/kg/min requires discussion on an individual patient basis with the named consultant and is not routine practice on the Children's Heart Centre.

Milrinone should be administered via a continuous infusion using the Standard Concentration Drug Library (See *SOP for the Preparation of Standard Concentration Infusions and the use of Drug Library and Smart Pumps in the Children's Heart Centre*). Infusion changes should be performed promptly with minimum interruption.

Considerations

Patients who are receiving IV milrinone require the following throughout the course of their treatment:

- Nurse 1:2
- Nurse with emergency equipment nearby and facility to intubate and ventilate as required
- Patient requires baseline observations prior to commencing infusion. Acceptable parameters of vital signs to be set by the Consultant Cardiologist. Continuous HR and SaO2 monitoring with hourly BP's until deemed stable by the cardiologist
- CVAD or at least I.V Cannula x2 in situ
- Strict intake and output monitored
- ECG, fluid balance, electrolytes and renal function (i.e. serum creatinine) at least twice weekly. Note whilst it is uncommon for milrinone to alter LFT's, it may be advisable in some circumstances to check for changes to baseline LFT's.
- New I.V. Infusion should be prepared at least every twenty four hours
- Daily Cardiac Team review with either Cardiology Consultant or Medical Registrar review at weekends
- If any acute deterioration, patient to be transferred to an ICU bed

Prescribing of Milrinone Infusion:

Milrinone must be prescribed on 'Intravenous Infusions' section of the patient's OLCHC Medication Kardex specifying:

- Amount of milrinone, diluent, and final volume (as per the Standard Concentration Drug Library for CHC)
- Rate of infusion in microgram/kg/minute
- Signature including bleep & IMC no.
- Prescription has to be dated and re-signed daily by prescriber

Procedure for the preparation of Milrinone Infusion:

Nursing staff preparing and administering milrinone must ensure:

- Concentration of infusion and prescribed rate is correct as per CHC Standard Concentration Drug Library Table

STANDARD CONCENTRATION DRUG LIBRARY FOR CHILDREN'S HEART CENTRE (FOR USE WITH B.BRAUN PUMPS DRUG LIBRARY)					Actual Rate = Actual Dose X Default Rate (mls/hour) (mls/hour) Default Start Dose	
Drug	**Weight**	**Standard Concentration**	**Diluent**	**Usual Dose Range**	**Default Start Dose**	**Rate calc(ml/hr) for default start dose.**
Milrinone	≤5kg >5-≤10kg >10-≤20kg >20kg	5mg/50mL 10mg/50mL 20mg/50mL 50mg/50mL (neat)	Glucose 5%w/v NaCl 0.9%w/v	0.25-0.75 microgram/kg/min	0.5microgram/kg/min	0.3 X Wt (kg) 0.15 X Wt (kg) 0.075 X Wt (kg) 0.03 X Wt (kg)

- Syringe is prepared accurately using antiseptic non-touch technique and clearly labelled with drug name, concentration, diluent, patient name and MRN number, date, time of preparation, and two nurses' signatures. See example below:

Sample Prescription

Infusion Fluid or Base Solution →	SODIUM CHLORIDE 0.9%	Final Volume (mL) 50ml
Medication or Electrolyte to be added →	Name MILRINONE Quantity 10MG	
Rate →	0.25 MICROGRAM/KG/HOUR	
Additional Instructions →		Batch no./EXP (if applicable)

Sample Syringe Preparation:

1. Milrinone injection contains 10mg in 10mls.
2. Draw up 5mg of Milrinone (5mls) in a syringe.
3. Draw up the diluent (45mls Glucose 5%) in a separate syringe.
4. Add the **drug to the diluent** to make to final volume of 50mls
5. Invert the syringe several times to ensure the Milrinone is evenly mixed within.
6. Attach and prime giving set
7. Load into infusion pump, ensuring pump is securely clamped in position on I.V. pole
8. Program pump as per *SOP for the Preparation of Standard Concentration Infusions and the use of Drug Library and Smart Pumps in the Children's Heart Centre.*

NB. Two nurses must sign the 'Intravenous Infusions' section of the patient's OLCHC Medication Kardex for both the preparation of the syringe AND the programming of the pump.

To check rate

The dose in micrograms/kg/min will be displayed on the Smart Pump. However, it is good practice for all staff to check this rate against the prescription at initiation, following rate changes, and when recording the rate on the volume flow sheet.

It is imperative to check the concentration in the syringe matches the concentration selected on the smart pump. Caution: Drug concentrations are not currently always stacked in any particular order

Step 1: Calculate the rate for the default start dose i.e. 0.5 micrograms/kg/min

a) Go to the column labelled 'rate calc [ml/hr] for default start dose' in the standard concentration infusion table
b) Calculate the rate for the default start dose as per given formula (0.3 x pts weight)
   E.g. = 0.3 x 4.5kg =1.35mls/hour.
   This is the rate (mls/hour) the pump would run at if this child's milrinone was prescribed as 0.5micrograms/kg/min.

Step 2: Calculate the rate for the prescribed dose (0.25microgram/kg/min) using the formula:

$$\frac{\text{Prescribed dose (actual dose)}}{\text{Default start dose}} \times \text{Default Rate (mls/hour)} = \frac{0.25}{0.5} \times 1.35 = 0.675\text{mls/hour}$$

Note: Smart Pump will round this to 0.67mls/hour (2 decimal places) and will then display the corresponding dose(to 3 decimal places) e.g. 0.248microgram/kg/min

Adverse Reactions associated with Milrinone

Common (≥1/100, ≤1/10):
Arrhythmias (related to dose or plasma levels)
Hypotension/vasodilatation
Headaches (usually mild to moderate in severity)
Ventricular ectopic activity

Uncommon*: *(≥1/1000, ≤1/100)
Hypokalemia
Thrombocytopenia
Chest pain
Altered LFTs

This list is not exhaustive and more information can be obtained by checking the product SPC or contacting the Pharmacy Department.

Milrinone is cleared by renal excretion and has a volume of distribution that is restricted to extracellular space which suggests that the fluid overload and hemodynamic changes associated with patent ductus arteriosus may have an effect on distribution and excretion of milrinone.

In addition, Milrinone has been shown in-vivo to induce dose dependant dilation of the constricted ductus arteriosus. The premature ductus arteriosus is more sensitive to milrinone than the mature.

All adverse events must be reported to medical staff. A medication safety incident report should also be submitted via the hospital's incident management system. Decisions regarding increasing, decreasing or discontinuing Milrinone will be made by the patient specific Consultant Cardiologist in charge.
Should any adverse reaction occur during treatment please report to the Health Products Regulatory Authority (HPRA) via {available at https://www.hpra.ie/homepage/about-us/report-an-issue/human-adverse-reaction-form}. It allows continued monitoring of the benefit/risk balance of the medicinal product.

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