Magnesium Sulphate for Refractory Status Epilepticus

(For patients who are not responsive to standard Status Epilepticus management)

Preparation available in KKH Formulary: 49.3% w/v $MgSO_4$ (equivalent to 10mmol/5mL)

Each milliliter contains = 2 mmol Mg^{2+} = 493mg $MgSO_4$

Target serum level : 2 to 4 mmol/l	**Clinical target**: Electroencephalographic seizure control

Dosing regimen:

Loading: 50mg/kg over 30 minutes (Maximum dose= 4g/dose)

Maintenance: Start at 20mg/kg/hr (Range 20 mg/kg/hr to 40mg/kg/hr)

Maximum infusion dose: 40mg/kg/hr (Recommended maximum daily dose= 40g/day)

Dilution :

Loading:

Load 50mg/kg $MgSO_4$ (≈0.1ml/kg of 49.3% w/v $MgSO_4$) over 30 minutes (Max rate : 150mg/min) Dilute every 1 ml of 49.3% $MgSO_4$ with 2.5 ml 0.9%NaCl

Maintenance (via CENTRAL LINE):

Dilute 500mg Mg (= 1ml 49.3% w/v $MgSO_4$) X **Body Weight** with 0.9% NaCl to a total volume of 50ml

To give infusion rate of 1ml/hr = 10 mg/kg/hr

Run between 1ml/hr to 4ml/hr (=10mg/kg/hr to 40 mg/kg/hr)

Ordering in CLMM:

1) Search under NEM.Status Epilepticus.KKH -> 2nd line after BZD (> 1yo):

	Medication Name	Dosing Information	Route	Dose	UOM	Frequency	Order Priority	Calc Dose Info	Start Date	Base Solution	Infuse	Over
Medications - 2 item(s)												
☐	LoRAzepam Injection	Dose: 0.1mg/Kg. Max 4mg	IV Bolus		mg	Once	Routine		T			
☐	Diazepam Enema	Dose: 0.4mg/Kg/DOSE. Max 10mg	Rectal		mg	Once	Routine		T			
2nd line after BZD(>1yr) - 4 item(s)												
☐	Phenytoin Sodium Injection	Dose: 20mg/Kg/DOSE	IV Intermittent		mg	Once	Routine		T	Sodium Chloride...	20	minute
☐	Magnesium Sulfate 49.3%...	Max Dose: 4g/dose...	IV Intermittent		mg	Once	Routine		T	Sodium Chloride...	30	minute
☐	Magnesium Sulfate 49.3%...	Max Dose: 40mg/kg/hr or up to...	IV Continuous		mg	<Continuo...	Routine		T	Sodium Chloride...	24	hour
☐	Calcium Gluconate 10%...	Max Dose: 4.5mmol/20mL...	IV Intermittent		mL	Once	Routine		T	Sodium Chloride...	10	minute
2nd line after BZD (<1yr) - 1 item(s)												
☐	Phenobarbital Sodium Injection	Dose: 20mg/Kg/DOSE	IV Intermittent		mg	Once	Routine		T	Sodium Chloride...	20	minute

2) Select the desired drug (e.g. $MgSO_4$) by ticking the box next to it and untick the rest.

3) Check to make sure the weight of the patient is most current.

4) The order set will auto-calculate the dose of drug based on the current weight of the child.

5) Countercheck the dose (e.g. $MgSO_4$) by using the formula provided:

E.g. # Dilute **500mg Mg** (= 1ml 49.3% w/v $MgSO_4$) X **Body Weight**

6) Please tick the box for **"FLUID RESTRICTED"** if you need to reduce the total infusion volume**.**

7) Submit the order set.

Important Note:

The order set for $MgSO_4$ Continuous infusion is **appropriate up for weight <50KG**

Once the weight of the patient **EQUALS or EXCEED > 50KG**, the volume of the 49.3% w/v $MgSO_4$ **(500mg Mg /1ml)** required may exceed the base volume of 50ml of 0.9% NaCl set by default.

Henceforth, we need to decrease the dose ordered per the base volume of 50ml 0.9% NaCl and run more volume per hour to maintain the same rate of $MgSO_4$ infusion.

E.g. Weight of patient = 68kg.

#Dose required= **500mg Mg** (= 1ml 49.3% w/v $MgSO_4$) X **68kg (Body Weight)**=**34, 000mg Mg** However

34, 000mg Mg alone constitutes to 68ml (based on the concentration of 500mg Mg /1ml) which will

EXCEED the base solution of 50ml NaCl 0.9%.

Henceforth reduce the concentration by **decreasing the $MgSO_4$ dose by HALF**

i.e. **34, 000mg Mg ÷ 2= 17,000 mg** (which constitutes to 34ml)which will fit in the base solution of **50ml** NaCl 0.9%.

Final order will be:

Dilute **17,000 mg $MgSO_4$** with **0.9% NaCl** to a total volume of **50ml i.e every 1ml/hr = 5 mg/kg/hr**

Run between 1ml/hr to 4ml/hr (=5mg/kg/hr to 20 mg/kg/hr)

Clinical parameters monitoring:

1) Heart Rate, Blood Pressure, Respiratory Rate every 15 minutes
2) SpO2 continuous
3) GCS every 15 min for 1st hour, then hourly thereafter
4) Patellar/Deep tendon reflexes every hourly
5) Urine output every hourly

Suggested timings for Serum Mg Level Monitoring :

- At 0 minute: Mg levels (together with measurement of baseline urea, electrolytes & creatinine)
- At 1 hour after end of loading dose
- Then every 4 hourly during infusion titration **OR**
- Every 6hourly when serum level reaches therapeutic range (2 to 4mmol/L) and infusion rate is stable
- **Repeat serum Mg level promptly if:**
  - Decreased urine output < 1ml/kg/hr
  - Depressed deep tendon reflex (if previously deep tendon reflex intact)
  - Hypotension
  - Arrhythmia

Clinical management of $MgSO_4$ toxicity

Range	Serum Mg level (mmol/L)	Physical Signs & Symptoms	Follow-up actions
Therapeutic	**2.0-4.0**	Peripheral vasodilation with facial flushing, sense of warmth, nausea and vomiting. These signs and symptoms may occur with overly rapid administration	For intravenous injection, concentration of $MgSO_4$ should **NOT exceed 20%.** Dilute 1 part of 49.5% with at least 2 parts of water for injection and administer the infusion over at least 20mins
Toxic	**4-5**	Deep Tendon Reflexes arrested	1) Half the Magnesium infusion 2) Repeat Mg levels urgently
	5-6	Respiratory function depressed	1) Discontinue Magnesium 2) Repeat Mg levels urgently
	6-7.5	Respiratory function arrested	1) Discontinue Magnesium 2) Infuse calcium gluconate 10% 0.5 -1 ml /kg/dose or 0.11mmol/L/dose over 10 minutes (Max=20 ml/dose or 4.5 mmol/L) 3)Repeat Mg levels urgently 4) Standby for intubation if patient is not intubated

Clinical management of $MgSO_4$ toxicity			
Range	**Serum Mg level (mmol/L)**	**Physical Signs & Symptoms**	**Follow-up actions**
Toxic	**7.5-10**	Cardiac depression: Arrhythmia, bradycardia, heart block	1) Discontinue Magnesium infusion 2) Infuse calcium gluconate 10% 0.5 -1 ml /kg/dose or 0.11mmol/L/dose over 10 minutes (Max=20 ml/dose or 4.5 mmol/L) 3) Repeat Mg levels urgently 4) Standby resuscitation equipment
	> 10	Cardiac Arrest	1) Discontinue Magnesium infusion 2) Infuse calcium gluconate 10% 0.5 -1 ml /kg/dose or 0.11mmol/L/dose over 10 minutes (Max=20 ml/dose or 4.5 mmol/L) 3) Repeat Mg levels urgently 4) Standby resuscitation equipment

MgSO4 infusion titration:

If Mg level > 5 mmol/L : Stop maintenance and repeat Mg level 1 hour later

If Mg level is between 4.1 to 5 mmol/L : Half the maintenance dose and repeat Mg level 1 hour later

If Mg level < 2 mmol/L : Increase $MgSO_4$ maintenance infusion by 10mg/kg/hr (max infusion is 40mg/kg/hr)

Antidote dosing:

0.5ml/kg (max 20ml) of 10% Calcium gluconate over 10 minutes (1mL= 94mg Calcium Gluconate = 0.23 mmol/mL Ca^{2+})

Disclaimer:

The above suggested MgSO4 continuous infusion protocol for management of refractory status epileptics is for informative purpose, it is not a substitute for good clinical judgment.