



Role of Neuromuscular Junction Monitoring in Management of a Post Partum Eclamptic Patient with Iatrogenic Hypermagnesemia.

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Abstract

Neuromuscular function is monitored by evaluating the muscular response to the supramaximal stimulus of a peripheral motor nerve. Acceleromyography (AMG) is the most accurate & reliable monitoring method commercially available to measure Neuromuscular blockade objectively in clinical setting. Accidental hypermagnesemia is very common and often missed complication in postpartum eclamptic patient. As symptomatic hypermagnesemia leads to neuromuscular junction blockade, neuromuscular junction monitoring serves the purpose of vigilant monitoring and prevents iatrogenic overdose of magnesium. We report a case of eclamptic patient who was treated with magnesium sulphate and has developed clinically significant neuromuscular weakness and required admission in the critical care unit. Acceleromyography definitely helped us diagnosing hypermagnesemia before serum magnesium levels were available; objectively monitoring the neuromuscular weakness and also response to the critical care management as it also curtailed the need for other investigations.



Introduction

Accidental hypermagnesemia is very common and often missed complication in postpartum eclamptic patient. Additional doses of magnesium in postpartum without assessing for hypermagnesemia can be detrimental. As symptomatic hypermagnesemia leads to neuromuscular junction blockade, neuromuscular junction monitoring serves the purpose of vigilant monitoring and prevents iatrogenic overdose of magnesium.

Case Report

A 20 year old young primigravida patient (weight 41 kg), post delivery was admitted to critical care unit. She had altered sensorium responding only to painful stimulus but spontaneously breathing in oxygen mask with pulse rate=94/ minute regular, BP= 140/100 mmHg, Respiratory Rate= 40 per min with shallow breathing, CVP= 4-6 cm H₂O, SPO₂= 95%. On auscultation, crepitations were heard on left interscapular, infrascapular and infra mammary region. Both heart sounds were normal with no murmur. On examination, pupils were bilaterally equal and reacting to light, no apparent facial palsy, gag reflex present. On motor examination, there were no active limb movements present. All four limbs showed signs of hypotonia, and power of 2/5. Deep tendon reflexes were absent at elbow, wrist, knee and ankle joints. Plantar were down going. Sensory system could not be judged properly since patient was in altered sensorium. A five cable ECG, pulse oximeter, NIBP cuff and Organon TOF-Watch SX monitor was attached and all routine investigations were sent.

She had history of two episodes of generalized tonic clonic convulsions a night prior to admission to J J Hospital. She was given Inj. Magnesium Sulphate 4 gm intravenous slow bolus followed by 5 gm intramuscular in each buttock (total 14 gms) in a rural hospital at night and was immediately referred to our centre. On admission in the morning, she again had generalized convulsions in ER and was again loaded with Inj. Magnesium Sulphate 4 gm intravenous bolus and 5 gm intramuscular in each buttock (total 14 gm). On obstetrical examination she was full term, vertex presentation, fully dilated cervix with meconium stained liquor. She delivered a male still birth weighing 2.15 kg four hours after the admission. Another dose of 4 gms of Inj. Magnesium Sulphate was given intravenous post delivery.

Her arterial gases revealed PO₂123.2mmHg, PCO₂ 18.6 mmHg, PH 7.535(suggestive of uncompensated respiratory alkalosis), cHCO₃20.5 mmol/l, BEecf -7.3mmol/l, Na 139.0 mmol/l, Cl 102.3 mmol/l, iCa 1.044 mmol/l, K 3.68mmol/l. Hct on ABG was 44.1%. Her 12 lead ECG was within normal limit. Her chest X-ray revealed haziness in left middle zone suggestive of early aspiration pneumonitis. (Fig-1)



Figure:1 Chest X-ray AP view on admission (day1) in critical care unit.

On admission to CCU, the neuromuscular junction monitoring by TOF watch revealed a best response as TOF count of one on consecutive readings which were way below normal response (TOF ratio of more than 90%). This was again suggestive of severe neuromuscular weakness. (Fig 2, 3)

Time	Mode	Tw1 %	Tw2 %	Tw3 %	Tw4 %	TOF %	CNT	Temp °C	Stim mA	T μs	Sens.	CAL [Curr.] - [mA]
12:56:17 PM	TOF - single	0	0	0	0	0	0	24.0	50.00	200	157	
12:59:02 PM	TOF - single	0	0	0	0	0	0	24.2	50.00	200	157	
01:13:41 PM	TOF	3	0	0	0	0	1	24.7	50.00	200	157	
01:13:56 PM	TOF	3	0	0	0	0	1	24.7	50.00	200	157	
01:14:11 PM	TOF	3	0	0	0	0	1	24.8	50.00	200	157	
01:28:57 PM	TOF - single	3	0	0	3	1	1	25.4	50.00	200	157	
01:41:02 PM	TOF - single	15	0	3	12	1	1	26.0	50.00	200	157	
01:42:02 PM	TOF	9	0	0	0	0	1	26.0	50.00	200	157	
01:42:17 PM	TOF	5	0	0	0	0	1	26.0	50.00	200	157	
01:55:20 PM	TOF - single	5	0	0	0	0	1	26.6	50.00	200	157	
01:57:17 PM	TOF	9	3	3	0	0	3	26.5	50.00	200	157	
01:57:32 PM	TOF	10	3	0	0	0	2	26.6	50.00	200	157	
01:57:47 PM	TOF	29	3	0	0	0	2	26.6	50.00	200	157	
01:58:02 PM	TOF	21	0	0	0	0	1	26.6	50.00	200	157	
02:06:30 PM	TOF - single	12	3	0	0	0	2	27.0	50.00	200	157	
02:13:29 PM	TOF - single	25	3	0	0	0	2	27.1	50.00	200	157	
02:28:02 PM	TOF - single	28	33	11	41	146		27.4	50.00	200	157	
02:28:16 PM	TOF	30	>160	6	14	--		27.5	50.00	200	157	
02:28:31 PM	TOF	42	28	23	7	16		27.4	50.00	200	157	
02:28:46 PM	TOF	34	35	29	6	17		27.2	50.00	200	157	
02:29:01 PM	TOF	144	7	8	4	2		27.3	50.00	200	157	
02:35:39 PM	TOF - single	15	6	12	7		4	28.1	50.00	200	157	
02:39:19 PM	TOF - single	34	4	0	0		2	28.3	50.00	200	157	
02:43:39 PM	TOF - single	13	0	0	0		1	28.0	50.00	200	157	
02:45:02 PM	TOF - single	40	11	3	0		3	28.0	50.00	200	157	
02:50:36 PM	TOF	37	13	0	6		2	28.6	50.00	200	157	
02:50:51 PM	TOF	42	8	0	3		2	28.6	50.00	200	157	
02:51:06 PM	TOF	40	9	3	3	7		28.6	50.00	200	157	
02:51:21 PM	TOF	44	8	3	3	6		28.7	50.00	200	157	
03:13:53 PM	TOF - single	29	10	8	12	41		29.6	50.00	200	157	
03:14:13 PM	TOF - single	18	22	25	30		4	29.3	50.00	200	157	
03:59:36 PM	TOF - single	46	10	34	32	69		30.2	50.00	200	157	
03:59:51 PM	TOF - single	82	139	84	17	20		30.2	50.00	200	157	
04:01:49 PM	TOF - single	107	70	25	16	14		29.9	50.00	200	157	
04:03:31 PM	TOF - single	40	33	15	11	27		30.0	50.00	200	157	
04:03:49 PM	TOF	88	53	18	15	17		29.9	50.00	200	157	
04:04:04 PM	TOF	>160	59	15	12	--		29.9	50.00	200	157	
04:04:19 PM	TOF	143	39	10	10	6		29.7	50.00	200	157	
04:34:48 PM	TOF - single	78	15	25	17	21		30.7	50.00	200	157	
04:35:11 PM	TOF - single	86	53	28	20	23		30.6	50.00	200	157	
04:42:11 PM	TOF - single	72	45	26	28	38		30.4	50.00	200	157	
05:03:58 PM	TOF - single	65	68	96	95	146		31.1	50.00	200	157	
05:08:27 PM	TOF - single	103	116	95	126	122		31.5	50.00	200	157	
05:46:50 PM	? Missing data											
05:48:59 PM	TOF - single	51	49	40	37	72		29.5	50.00	200	157	
06:02:31 PM	TOF - single	108	110	103	100	92		29.6	50.00	200	157	
06:28:24 PM	? Missing data											
06:28:45 PM	TOF - single	65	71	68	68	104		27.8	50.00	200	157	
07:00:49 PM	TOF - single	86	62	71	59	68		26.5	50.00	200	157	
07:01:03 PM	TOF - single	134	121	84	82	61		26.4	50.00	200	157	
07:01:09 PM	Powered Off							26.3	50.00	200	157	
07:02:17 PM	TOF - single	82	66	56	61	74		26.0	50.00	200	157	
07:02:24 PM	Powered Off							26.0	50.00	200	157	

Figure 2: TOF Recordings

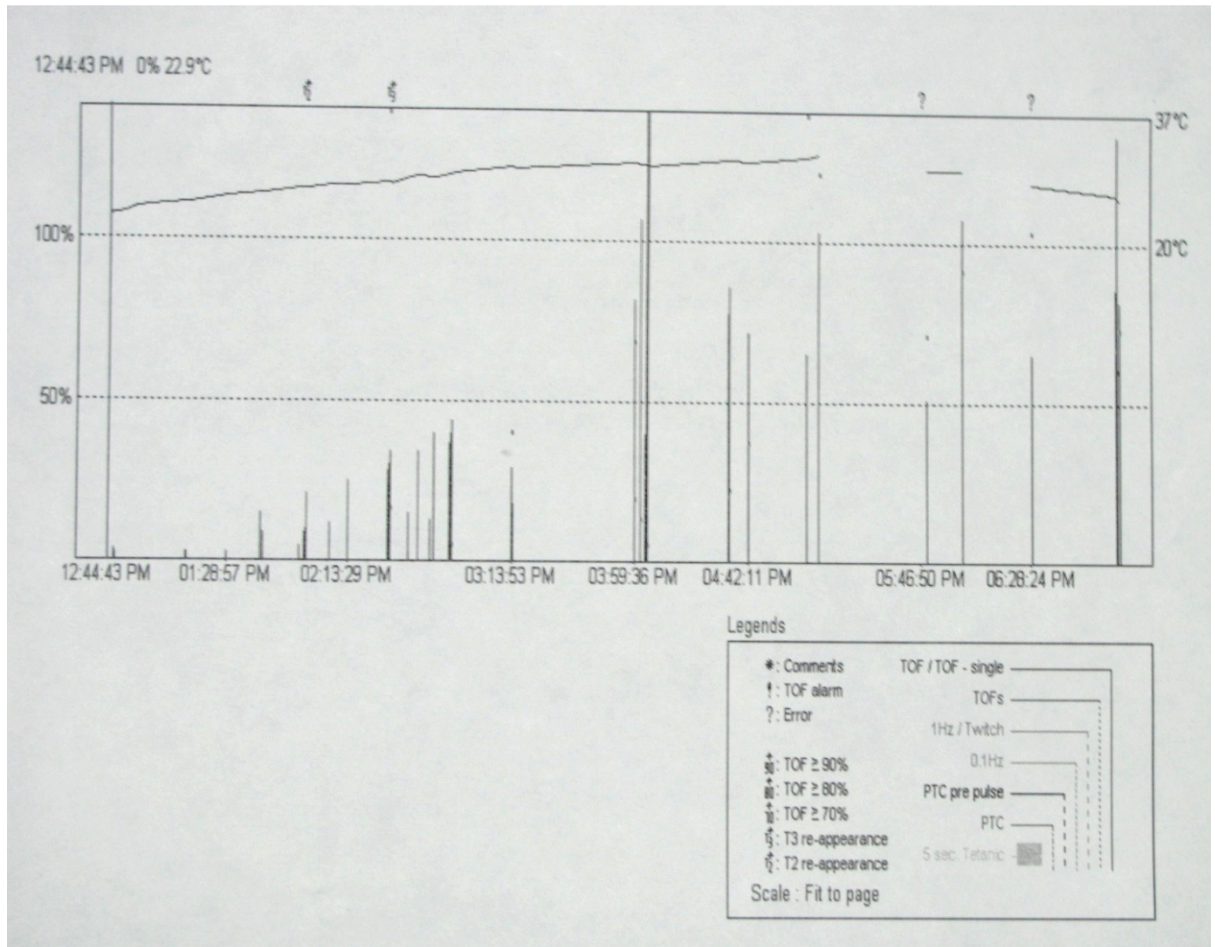


Figure3: TOF Recordings

Her biochemical investigations revealed Hb= 13.7gm%, TLC= 10800, urea = 43mg, creatinine =1.0mg, RBS =118 mg and PT= 15 sec against control of 12 seconds. Her serum magnesium levels were 5.2 mg% (Normal range 1.5-2.5mg %).

In view of raised serum magnesium levels with signs & symptoms of neuromuscular weakness, hypermagnesemia was diagnosed. Inj Calcium gluconate (10%) 10 ml diluted to 20 ml was given slow intravenous bolus over a period of 20 minutes. Her central venous pressure was maintained at 8-10cmH₂O with intravenous Ringer Lactate, as her urine output was maintained at 1 ml/kg. She was given active chest physiotherapy along with normal saline nebulisation to improve her chest condition.

The four hourly prophylactic dose of magnesium sulphate was not given due to absent deep tendon reflex and increased serum Magnesium levels. Patient's general condition improved after six hours of admission to CCU as she started opening her eyes spontaneously, responding to simple verbal commands. Her motor examination revealed improved power of 4/5 in both upper limbs and 3/5 in both lower limbs but still the deep tendon reflexes were absent with improvement in her TOF ratios in neuromuscular

junction monitor(TOF ratios 60-70), (Fig- 2, 3). Her respiratory rate was decreased to 18 per minute. The patient was continued with injectable antibiotics inj cefuroxime 1 gm BD & inj metronidazole 100 mg TDS and her serum electrolytes were maintained within normal limits.

Patient's condition continued improving as she became more oriented, started identifying the relatives & accepted sips of water at twelve hours of admission. Her motor examination revealed active limb movements and 5/5 power in all the limbs and normal deep tendon reflexes. Her serum magnesium level was 2.6 mg%. Tab Amlodepine 5 mg was started orally.

After 24 hours of admission, patient started accepting liquid diet. Her central nervous system examination revealed active limb movements with 5/5 power & normal deep tendon reflexes. Her respiratory conditions also improved with RR 18/ min, SPO₂99%, equal air entry in all lung fields with occasional crepitations on left side. Her ABG revealed PaO₂ 134 mmHg, PCO₂ 34.9, pH 7.39, HCO₃ 21.6 mmol/l, BE -3.4 mmol/l , SO₂ 99.1%, Na141 meq/lit, K4.1meq/lit, Cl 104.2 meq/lit.

Patient was observed for another 24 hours in CCU. She accepted normal diet. A repeat chest X-ray was suggestive of decreased haziness in the left lung field (Fig. 4). She was shifted to ward and where she was observed for three more days & subsequently discharged on fifth day of her admission to J J Hospital.

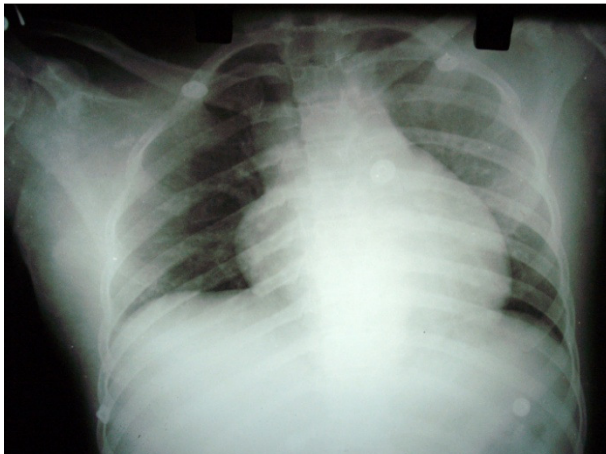


Figure 4: Chest X- Ray PA view on day 3 in critical care unit.

Discussion

Acute onset generalized weakness results from electrolyte disturbances like hypokalemia, hyperkalemia, hypercalcemia, hypermagnesemia, hypophosphatemia, muscle disorders, Neuromuscular junction disorders like Myasthenia gravis, Lambert Eaton



syndrome and CNS disorders like transient ischemic attack of brainstem, transient global cerebral ischemia¹.

Preeclampsia and eclampsia are the most common condition seen by obstetric anaesthesiologists in which an otherwise healthy parturient can become critically ill². Preeclampsia when complicated with convulsions and or coma is called eclampsia. It occurs more commonly beyond the 36th week and most commonly occur before onset of labour³. The exact cause of convulsion is not clear. But hypoxia due to cerebral vasoconstriction is the most thought mechanism³. Most of the eclamptic convulsions subside within 24 hours of termination of pregnancy.

Treatment of preeclampsia is control of hypertension, prevention of seizures and delivery of the foetus. Magnesium sulphate is the agent of choice for the control and prevention of recurrent eclamptic seizures. Magnesium appears to act primarily by relieving cerebral vasospasm⁴. The results of the Collaborative Eclampsia Trial show that women treated with magnesium sulphate have fewer recurrent seizures compared with women treated with diazepam or phenytoin⁵. FOGSI (The Federation of Obstetric & Gynaecological Societies of India) recommends a loading dose of Magnesium Sulphate 4g should be given over 5-10 minutes intravenous followed by a intramuscular maintenance regime-5g every 4hrly intramuscular, continued for at least 24 hours after the last seizure or delivery whichever is later. Recurrent seizures should be treated by a further bolus of 2g. (Grade A recommendation)⁶. Respiratory rate, knee jerks & urine output are important parameters to pick up magnesium toxicity.

Symptomatic hypermagnesemia (despite normal renal function) has been reported with magnesium infusions. The typical setting is the treatment of preterm labor or preeclampsia or eclampsia. Standard obstetric protocols (4 to 6 g load followed by 1 to 2 g/h) result in serum magnesium levels of 4 to 8 mg/dl. Patients suffering accidental parenteral magnesium overdoses usually have good outcomes, despite significant short-term morbidity⁷.

Manifestations of hypermagnesemia are based on this ion's effect on the central nervous system (CNS), cardiovascular system, and neuromuscular junction. CNS manifestations include drowsiness, confusion, lethargy, and coma. Effects on the cardiovascular system include hypotension and dysrhythmias. These effects are caused by the calcium channel-blocking properties of magnesium, which decreases entry of calcium into cells and enhances egress of calcium from cells⁸. At the neuromuscular junction, magnesium sulphate decreases the amount of acetylcholine liberated, diminishes the sensitivity of the endplate to acetylcholine, and depresses the excitability of the muscle membrane^{8,2}. This results in skeletal muscle weakness and respiratory distress. Clinical signs and symptoms correlate with plasma concentrations. ECG changes (prolongation of the P-R



interval, increased duration of the QRS complex, and increased height of the T waves) are noted with concentrations of 6–12 mg/dL (5–10 mEq/L), respiratory paralysis and sinoatrial and atrioventricular block occurs at 18 mg/dL (15 mEq/L), and cardiac arrest occurs at 30 mg/dL (25 mEq/L)^{9,10}.

Neuromuscular function is monitored by evaluating the muscular response to the supramaximal stimulus of a peripheral motor nerve. Objective neuromuscular monitoring is commonly used in clinical anaesthesia practice to evaluate the degree of neuromuscular blockade and also during recovery. Various methods such as Mechanomyography, Electromyography, Phonomyography are available but Acceleromyography (AMG) is the most accurate & reliable monitoring method commercially available to measure Neuromuscular blockade objectively in clinical setting¹¹. We used TOF- Watch (Organon Ltd, Dublin) monitor which is based on measurement of acceleration using a piezoelectric transducer & TOF ratio is given as percentage. A ratio more than 100 percent is considered normal neuromuscular functioning¹².

In our case patient had eclamptic convulsions when she was at home, at rural hospital and again in emergency ward. Patient was loaded with Inj Magnesium sulphate thrice. Patient definitely had signs of hypermagnesemia when presented to us in critical care unit with absent deep tendon reflexes, decreased TOF responses on neuromuscular junction monitor and raised Serum magnesium levels. The prophylactic doses of magnesium sulphate were avoided subsequently and patient responded to the treatment of hypermagnesemia. Neuromuscular junction monitoring definitely helped us diagnosing hypermagnesemia before serum magnesium levels were available, objectively monitoring the neuromuscular weakness and also response to the critical care management as it also curtailed the need for other investigations. Neuromuscular junction monitor has helped us in reducing the morbidity of this patient.

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