Original Article

Spectrum of Movement Disorder Emergencies in a Tertiary Care Center in India: A Prospective Observational Study

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Abstract

Introduction: Movement disorders can present in emergency services in an acute severe form which can be life threatening if not recognized. The relative frequency and spectrum of movement disorder emergencies have not been studied extensively. We studied the frequency, spectrum, and outcome of patients presenting with movement disorders emergencies. **Methods:** This was a prospective, descriptive single center study. Patients presenting with acute movement disorders to the neurology emergency services of the institute during the study period from April 2019 to June 2021 were analyzed. **Results:** A total of 71 patients presented with acute movement disorders during the study period. Out of them, 65 patients had hyperkinetic and 6 patients had hypokinetic movement disorders emergencies. Fifteen patients were below the age of 18 years. Chorea (59.1%) was the most common movement disorder emergencies followed by dystonia and myoclonus in adults. Dystonia (33.3%) was the common movement disorder emergencies in children. Hyperglycemia followed by stroke was the most common etiology of acute movement disorders. **Conclusion:** This study brings out some novel findings on the movement disorders emergencies in Indian scenario. Chorea was the most common movement disorder emergencies presenting to the neurology emergency services. Early recognition and management of movement disorders emergencies help in reducing morbidity.

Keywords: Emergencies, hyperkinetic, hypokinetic, movement disorder

Introduction

A movement disorder (MD) emergency can be defined as any MD that evolves over hours to days in which failure to diagnose and manage patients appropriately can result in high morbidity and mortality. The early recognition and effective management of MD emergencies (MDE) can favorably alter the outcomes.[1] MDE can be hyperkinetic or hypokinetic emergencies. Hyperkinetic MDE include chorea/hemiballismus, dystonia, tremor, and myoclonus which can present in acute and aggressive forms. Hypokinetic MDE include acute parkinsonism, neurolept malignant syndrome (NMS), malignant catatonia, parkinsonism-hyperpyrexia syndrome, and serotonin syndrome.[2,3] The overall prevalence of acute MD in an emergency setting is as low as 0.073%.[4] Most of the literatures available on MDE are in the form of case series and case reports. There are few large systematic studies on the MDE's globally and fewer from Indian subcontinent. Dallocchio C *et al.* (2019)[4] from Italy reported 96 patients with acute MD and majority was hyperkinetic MD. Tremor was the most common hyperkinetic MD in their cohort. Goraya JS (2015) from India reported acute MD in 92 children and myoclonus was the most common hyperkinetic MD.[5] The objective of this study was to study the clinical phenomenology, investigational characteristics, radiological findings, and the outcomes at discharge of patients presenting with MDE's at the tertiary care neurology emergency service in India.

Materials and Methods

This was a prospective, descriptive, observational study conducted in the neurology department of the National Institute of Mental Health and Neurosciences (NIMHANS), Bengaluru, a tertiary care center for neurological disorders in south India.

Patients presenting to the emergency department with hypokinetic and hyperkinetic MDE were included in the study.[2,3] Patients with psychogenic movement disorders and those not willing to give consent were excluded from the study. The study period was from April 2019 to June 2021. Written informed consent was taken from all the study participants. Ethical approval from the institute ethics committee was obtained (NIMH/DO/IEC (BS&NS Div/2019-20/07-06-2019). The study was conducted in accordance with the Declaration of Helsinki (1964).

The following data were collected from the study participants: sociodemographic details, symptoms at onset, duration of the MD, precipitating factors like fever, dehydration, drug intake or abrupt drug withdrawal, alcohol dependency, nicotine

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addiction, and presence of vascular risk factors such as hypertension, diabetes mellitus, pre-existing MD, and family history. The onset of disease was considered as hyperacute if it was within minutes to hours, acute if within hours to a day, subacute if it was days to weeks, and chronic if it was more than 4 weeks. A record of detailed clinical examination with documentation of the phenomenology and type of the movement disorder were done. The individual movement disorders were defined as per the standard clinical criteria. A video recording of the patient's movement disorder was done with consent. The severity of chorea as mild, moderate, and severe was assessed by the UFMG Sydenham's Chorea Rating Scale (USCRS), severity of dystonia as mild, moderate, severe by the Burke-Fahn-Marsden Dystonia Rating Scale (BFMDRS), and the severity of parkinsonism by the Unified Parkinson's Disease Rating Scale (UPDRS).[6-8] The biochemical investigations, brain imaging details, and electroencephalographic details if done were collected. The treatment details and outcome at the time of discharge or referral to other hospitals were recorded.

Statistical analysis

Data were analyzed with SPSS version 23 and Microsoft Excel sheet. Descriptive statistics like categorical variables and continuous variables were expressed using statistics like frequency, percentage, and mean and standard deviation, respectively. Normal distribution for all the variables was tested using Shapiros–Wilkis test. Independent t-test and Mann–Whitney U test was used for continuous variables following normal and not following normal distribution, respectively.

A P value of < 0.05 was considered significant.

Results

Around 45,000 patients with neurological emergencies attended the emergency services during the study period. A total of 90 patients with MDE attended the neurology emergency service. However, 71 patients fulfilling the selection criteria during the study period were included in the final analysis. Patients with psychogenic movement disorders, those who did not provide consent, and incomplete clinical information were excluded. The mean age of the patients was 45.4 ± 24.4 years (range 3–86 years). Forty patients were male and 31 were females. The mean age of the males was 42.9 ± 21.7 years (range 3–74 years) and females were 48.8 ± 24.2 years (range 3–86 years).

Movement disorder emergencies (n = 71)

The hyperkinetic MDE (n = 65) was predominant (91.5%) than the hypokinetic MDE (n = 6). Chorea (n = 42) was the predominant hyperkinetic MDE followed by dystonia (n = 11), myoclonus (n = 7), dyskinesia (n = 2), tics (n = 1), opsoclonus myoclonus syndrome (n = 1), and dystonic tremor (n = 1). Four patients had acute parkinsonism and one patient each had NMS and serotonin syndrome (SS). The symptom onset was acute in 47 patients (67.1%), subacute in 14 patients (20%), and hyperacute in 9 patients (12.7%). The mean time from onset of symptoms to presentation was 4.8 days. The main etiological factor was hyperglycemia which was seen in 18 patients (25.4%). Other etiologies were autoimmune in 10 (14%), stroke in 9 (12.7%), drug-induced in 9 (12.7%), infection in 7 (10%), infection-induced autoimmune in 2 (3%), metabolic in 3 (4.2%), genetic in 2 (3%), and undetermined in 9 patients (12.7%).

Table 1: Demographic, clinical, and radiological characteristics of patients with chorea

Chorea (n=42)	Values
Age[a] (years)	54.1±21.1 (8-86)
Gender (M/F)	20/22
Onset (n/%)	
Hyperacute	9 (21.4)
Acute	26 (61.9)
Subacute	7 (16.7)
Topographic distribution (n/%)	
Hemichorea	21 (50)
Generalised	13 (30)
Unilateral	
Face	5 (11.9)
Monochorea involving upper limb	3 (7.1)
Severity (n/%)	
Mild	4 (9.5)
Moderate	26 (61.9)
Severe	12 (28.6)
Etiology: (n/%)	
Hyperglycemia	19 (43.9)
Stroke	8 (19.5)
Autoimmune	6 (14.6)
Infection	2 (4.7)
Metabolic	1 (2.4)
Genetic	1 (2.4)
Drug-induced	1 (2.4)
Undetermined	4 (9.8)
Outcome: (n/%)	
Improved	23 (54.8)
Remained status-quo	17 (40.5)
Worsened at the time of discharge.	2 (4.7)
Chorea in hyperglycemia/diabetic striatopathy (n=19)	
CT head lesions (n=17) (n/%)	
Caudate and putamen	7 (41.1)
Putamen only	4 (23.5)
Caudate, putamen, and globus pallidus	2 (11.7)
No abnormality	4 (23.5)
MRI brain lesions (n=5) (n/%)	
Isolated putamen	2 (40)
Caudate and putamen	2 (40)
Caudate, putamen, and globus pallidus	1 (20)

[a]Mean±standard deviation (range); CT - computed tomography; MRI - Magnetic resonance imaging

Movement disorder emergencies in patients (<18 years of age) (n = 15)

About 21.1% of the patients with MDE were less than 18 years. The median age was 10.6 years (range: 3–17 years). Nine patients were males (60%) and six were females. All the

patients had hyperkinetic MDE. The most frequent MD was dystonia in five patients (33.3%), chorea in four (26.7%), myoclonus in three (20%), and one each for dyskinesia, tics, and opsoclonus myoclonus ataxia syndrome (OMAS). The most common etiological factor was autoimmune in five patients (33.3%) followed by infection in two, infection-induced autoimmune in two, metabolic in two, drug-induced in two, and genetic in one patient. A comparison of different studies on MDE in adult and pediatric cohort are summarized in Supplementary Tables 1 and 2.

Hyperkinetic movement disorder emergencies (n = 65)

Chorea (n = 42)

The demographic, clinical, and radiological characteristics of patients with chorea are summarized in Table 1. The median time from onset to presentation was 3 days (range 1 h to 15 days). The median duration of symptoms was 12.2 days ranging from 5 h to 45 days. The mean USCRS III score was 23.7 ± 11.1. Two patients had central nervous system infection that included tubercular meningitis with basal ganglia infarct and toxoplasmosis with retroviral disease causing hemichorea. One patient had generalized chorea secondary to accidental high-dose intake of chlorpromazine. At the time of presentation, 12 (28.6%) had the modified Rankin scale (mRS) score of 4 and 3 each, 6 (14.3%) had score of 5, 11 (26.2%) had score of 2, and 1 (2.4%) patient had score of 1.

Chorea in hyperglycemia/diabetic striatopathy (n = 19)

Hemichorea occurred in 16 (84.2%) patients, generalized chorea in 2 patients, and upper limb monochorea in 1 patient. Fourteen patients with hemichorea had unilateral CT/MRI lesion of striatopathy. Other two patients with hemichorea had bilateral CT/MRI lesions of striatopathy. Two patients with generalized chorea had bilateral CT/MRI lesions of striatopathy. One patient with monochorea had unilateral CT/MRI lesion of striatopathy. The mean blood glucose level at presentation was 261.6 mg/dl (range 59–1105 mg/dl). The mean glycated hemoglobin levels were 11.7% (range 5.6–17.2%).

Chorea in stroke (n = 8)

All eight patients with stroke presented with hemichorea. The infarcts were noted in corpus striatum in five patients (62.5%), one patient had thalamic and occipital infarct each, and thalamic bleed in one patient.

Chorea due to autoimmune etiology (n = 6)

Six patients with chorea had autoimmune etiology. Three patients had Sydenham's chorea (SC), one each had anti-N methyl D-aspartate (NMDA) receptor encephalitis, neuro-behcet disease, and anti-Ma2 antibodies associated encephalitis.

Dystonia (n = 11)

The demographic, clinical, and radiological characteristics of patients with dystonia are summarized in Table 2. The median duration of symptoms was 11.2 days, with a minimum of 4 h and a maximum of 45 days. The mean BFMD Rating Scale score was 78.7 ± 47.5 (range 4–120). At presentation, six (54.5%) had mRs score 5, two (18.2%) had mRS score 4, one each (8.3%) had mRS scores of 1, 2, and 3.

Table 2: Demographic, clinical, and radiological characteristics of patients with dystonia

Dystonia (*n*=11)	Values
Age[a] (years)	27.8±22.2 (3-71)
Gender (M/F)	6/5
Onset (*n*/%)	
Acute	7 (63.6)
Subacute	4 (36.4)
Topographic distribution (*n*/%)	
Generalized	8 (72.7)
Focal	2 (18.2)
Segmental	1 (9.1)
Severity (*n*/%)	
Mild	1 (9.1)
Moderate	2 (18.2)
Severe	8 (72.7)
Etiology: (*n*/%)	
Drug-induced	3 (27.3)
Stroke	1 (9.1)
Infection	1 (9.1)
Autoimmune	1 (9.1)
Infection-induced autoimmune	1 (9.1)
Genetic	1 (9.1)
Metabolic	1 (9.1)
Undetermined	2 (18.2)

[a]Mean±standard deviation (range)

Etiology

The drugs causing dystonia were risperidone, ondansetron, prochlorperazine, and levosulpride. The infective cause of dystonia was subacute sclerosing panencephalitis (SSPE). One patient had neuronal ceroid lipofuscinosis (NCL). Patient with NCL was an 8-year-old boy with multiple episodes of seizures, regression of all milestones, and dystonia, especially oromandibular dystonia. MRI brain showed diffuse cerebral and cerebellar atrophy. Electron microscopy of skin biopsy was diagnostic of NCL. The infection-induced autoimmune cause was a 3-year-old girl who had a 1-month history of febrile illness followed by multiple episodes of seizures with encephalopathy. She developed generalized dystonia followed by intermittent dystonic storm. MRI brain showed bilateral cystic encephalomalacia and necrotic changes in the anterior temporal lobe with diffusion restriction on the diffusion-weighted imaging.

Myoclonus (n = 7)

The mean age of the patients at presentation was 29.8 ± 29.3 years (range: 3–74 years). Six patients were males and one was female. The onset was acute in five (71.4%) and subacute in two (28.6%) patients. The mean duration of symptoms was 60 days (range 12 h–180 days). The main etiological factor was infection in three patients, autoimmune, infection-induced autoimmune, drug-induced, and metabolic in one patient each. Three patients had SSPE, one had SSPE with

Table 3: A brief summary of patients with hypokinetic movement disorders emergencies

Acute parkinsonism (*n*=4)	Description
Malignant subthalamic nucleus deep brain stimulation (STN-DBS) withdrawal syndrome (*n*=2)	Two patients of advanced Parkinson's disease with motor fluctuations and levodopa induced dyskinesias who had undergone bilateral STN-DBS presented with acute parkinsonism due to implantable pulse generator (IPG) drainage. Both patients improved with IPG replacement.
Multiple neurocysticercosis (NCC) (*n*=1)	A 53-year-old man presented with acute onset of tremors in the left upper and lower limb, with bradykinesia, mask-like face, and decreased volume of speech. His gait was short-stepped with decreased arm swing and stooped posture. MRI brain showed multiple NCC in bilateral cerebral hemispheres, basal ganglia, thalamus, and cerebellum.
Osmotic demyelination syndrome (*n*=1)	A 55-year-old lady presented with repeated vomiting and had hyponatremia which was corrected. She presented to emergency room with bradykinesia, rigidity, mask-like face, decreased blink rate, and decreased volume of speech. MRI brain was suggestive of extrapontine myelinolysis/ central pontine myelinolysis.
Serotonin syndrome (*n*=1)	A 51-year-old man was on fluoxetine and olanzapine for his behavioral disturbances since many years. The fluoxetine dose was increased recently from 60 mg/day to 80 mg/ day. He developed tremors of all limbs, hallucinations, and myoclonus. On examination, he had tachycardia, diaphoresis, tremors, myoclonic jerks with brisk deep tendon reflex, and ankle clonus. There was improvement after cessation of fluoxetine.
Neurolept malignant syndrome (NMS) (*n*=1)	A 20-year-old man came with fever, tachycardia, urinary incontinence, and extrapyramidal symptoms with stupor on a background history of recent use of olanzapine for behavioral symptoms. Serum creatine kinase levels were elevated. He was managed with adequate hydration, stoppage of olanzapine, and started on levodopa. There was significant improvement in the symptoms with the normalization of creatine kinase levels.

anti-NMDA receptor antibodies positivity, one had myoclonus due to cinnarizine and prochlorperazine prescription, one had seronegative autoimmune encephalitis, and one patient had opsoclonus myoclonus ataxia syndrome (OMAS).

Dyskinesia (n = 2)

Two patients had dyskinesia. A 53-year-old patient who was diagnosed as atypical parkinsonism was on levodopa 300 mg/day. He developed lower limb dyskinesias and was started on amantadine 200 mg/day. There was worsening of dyskinesias and became generalized. A 5-year-old with regression of milestones and ataxia presented with severe generalized dyskinetic movements. MRI brain showed bilateral symmetrical atrophy with periventricular white matter signal changes, brainstem, thalamic, caudate, and cerebellar atrophy. Skin biopsy electron microscopy was suggestive of NCL**.**

Tics (n = 1)

There was one patient who presented with severe motor tics (Tic Status). She had good improvement with tetrabenazine.

Hypokinetic movement disorder emergencies (n = 6)

Acute parkinsonism (n = 4)

Two patients presented to the emergency room with acute parkinsonism in a bed-bound akinetic rigid state due to the DBS implantable pulse generator (IPG) drainage. One patient presented with acute parkinsonism due to multiple neurocysticercosis (NCC) and another due to extrapontine myelinolysis/central pontine myelinolysis.

Serotonin syndrome (SS) and NMS (n = 1 each)

There was one patient who presented with serotonin syndrome and another patient with NMS. The details of the patients with hypokinetic MD emergencies are summarized in Table 3.

Discussion

MD are traditionally considered as chronic diseases which are commonly seen in out-patient services. However, they can present as acute, severe syndromes in the emergency room. Acute worsening of chronic MD can also present as emergency.[2] The overall prevalence of acute MD in an emergency setting is as low as 0.073%.[4]

There are several reviews on the MD emergencies, but studies on their relative frequency and their underlying diseases (systemic and neurological) are lacking.[9-11] Our study was a prospective analysis of patients presenting to the emergency room with movement disorders. In our study of 71 cases of MDEs, interestingly, hyperkinetic MD was the most common type (91.5%) with chorea (59.2%) as the predominant MD in our cohort. There was slight male predominance (56.3%) and the most common underlying etiology was hyperglycemia (25.4%) followed by stroke (12.7%), infection (9.9%), autoimmunity (14.1%), drug-induced (12.7%), and undetermined causes (12.7%). Dallocchio *et al.* (2018)[4] from Italy studied the spectrum and frequencies of acute MD in their cohort of patients aged ≥15 years. They studied 96 patients with acute MD during their 4-year study period and found acute MD frequency of 0.073% of the total patients admitted. Similarly, hyperkinetic MD (73.9%) was the predominant acute MD in their cohort. Tremor and myoclonus were the most common acute MD followed by parkinsonism, dystonia, and chorea in their cohort. The underlying etiology was drug-induced (29.2%), neurodegenerative diseases (15.6%), vascular/structural (11.5%), and others (24.0%) (metabolic, dysimmune/inflammatory, infective, and undetermined).

We had 15 patients with MDE in the age group of 3 to 17 years with a mean age of 10.6 years. Dystonia was seen in five patients (33.3%), followed by chorea in four patients (26.7%), myoclonus in three patients (20%), dyskinesia in one, tics in one, and OMAS in one patient. Autoimmune was the most common underlying etiology in our pediatric cohort. Similarly, Dale *et al*. (2010)[12] reported 52 pediatric patients aged between 2 months and 15 years with acute MD and the most common emergency MD was chorea in 38.5% followed by dystonia in 32.7%, tremors in 23%, myoclonus in 19.2%, and acute parkinsonism in 19.2%. The most common etiology was drug induced followed by NMDA-R encephalitis, post-pump chorea, opsoclonus-myoclonus syndrome, Sydenham's chorea, acute necrotizing encephalopathy, systemic lupus erythematosus, metabolic, other encephalitis, and vascular. Another study from India by Goraya JS (2015) on the spectrum and frequency of acute MD in 92 children showed similar predominance of the hyperkinetic MD. Myoclonus (27%) was the most common followed by dystonia in 23%, choreoathetosis in 21%, tremors in 16%, tics in two patients, and acute parkinsonism in three children. Inflammatory, autoimmune, and infectious etiology was the underlying etiology in 35% patients and metabolic/nutritional/drug induced in the rest.[5] Raucci U *et al*. (2018)[13] from Italy analyzed a large cohort of acute hyperkinetic MD in 256 children ≤17 years. Tics (44.5%) was the most common acute hyperkinetic MD followed by tremors, chorea, dystonia, myoclonus, and stereotypies. The common etiology were SC, PANDAS, autoimmune encephalitis including NMDA-R and OMS. Inflammatory conditions (infectious and immune-mediated neurological disorders) accounted for 17.6% of the cases, whereas non-inflammatory disorders (including drug-induced and genetic/metabolic diseases) accounted for 31.2%.

Hyperglycemia was the most common cause of acute chorea in our cohort. There was slight female predominance (52.4%) in patients with acute chorea. The prevalence of diabetes mellitus in India in the age group of >20 years is 7.7%. Nearly 65 million people in India have diabetes mellitus.[14] The prevalence of hypertension in India is 25.3% in the age group of >18 years which is nearly 207 million persons. This may explain the high incidence of hyperglycemia and stroke as cause of movement disorder emergency.[15] Diabetic striatopathy (DS) is a relatively uncommon hyperglycemic condition associated with chorea/ballism and unique reversible abnormality of basal ganglia on brain imaging with prevalence of 1 in 100,000. It occurs predominantly in elderly females with type 2 diabetes mellitus.[16] A review on 176 patients with diabetic striatopathy by Chua *et al*. (2020)[17] showed that 97.7% of patients had chorea or hemichorea. The most commonly involved region, in isolation or combination with the other two was putamen followed by the caudate nucleus and globus pallidus. Bilateral striatal involvement was noted in 9.7%. We also found the combined involvement of caudate and putamen as the most common radiological abnormality in diabetic striatopathy. Unilateral striatal involvement was seen in 79% of patients and bilateral in 21% of patients in our cohort. Stroke was the second most common cause of acute onset chorea in our study. The prevalence of undetected and uncontrolled hypertension and diabetes is very high in India and these are the most common vascular risk factors, leading to vascular atherosclerosis and stroke. In a study of 2500 patients with stroke, it was found that 1% developed acute or delayed movement disorder and 72% of cases of hemichorea-hemiballism (HC-HB) are due to stroke.[18] Lesions in caudate, subthalamic nucleus, putamen and/or globus pallidus, striatum (caudate nucleus and putamen), thalamus, frontal, and parietal cortex cause HC-HB.[19] Our cohort had eight patients with stroke and hemichorea and corpus striatum was the common site of stroke. Sydenham's chorea (SC) is the most common cause of acute chorea in children. The age of onset is 8 to 9 years with female preponderance. Most of the cases have generalized chorea with 20% having hemichorea.[20] There were three patients with SC and two patients had hemichorea and one had generalized chorea in our cohort. Paraneoplastic chorea is commonly associated with anti-Collapsin Response Mediator Protein 5 (CRMP5) antibodies. Other onconeural antibodies associated with chorea are anti-Hu, anti-SRY-Related HMG-Box Gene 1 (SOX1), anti-Purkinje cell cytoplasmic antibody, anti-Yo, and anti-Ri antibodies. Our cohort had a patient with paraneoplastic chorea associated with anti-ma2 receptor antibodies. Etemadifar M *et al.* (2017)[21] reported an elderly male with chorea of 3 years duration and was diagnosed as anti-ma2 receptor encephalitis. Movement disorders in neuro-Behcet's disease (NBD) are rare but chorea has been reported.[22] A middle-aged man in our cohort presented with hemichorea and investigations were suggestive of NBD. Chorea has been known to occur in anti-N-Methyl-D-Aspartate receptor (NMDAR) encephalitis.[23] Chlorpromazine overdose has been reported to cause NMS but we had a patient presenting with generalized chorea.

Drug-induced dystonia was the common cause of acute dystonia in our study. The drugs causing dystonia were risperidone, ondansetron and prochlorperazine, and levosulpiride. Acute dystonic reactions (ADRs) are mostly observed following an exposure to dopamine receptor blocking agents, antiemetics, and gastrointestinal promotility agents. Radhakrishnan DM *et al*. (2018) reported seven cases of levosulpiride-induced oromandibular dystonia. Three patients had jaw opening dystonia, three had orolingual dystonia, and one presented with cranio-cervical dystonia.[24] Our patient had acute onset generalized dystonia with levosulpiride which has not been described so far. Ondansetron and prochlorperazine are well known to cause ADRs. Two patients presented with status dystonicus were diagnosed as SSPE and NCL. Status dystonicus can result from both primary and secondary dystonia, and it can also occur as a side effect of acute symptomatic dystonia caused by infection, medications, brain injury, and so on. The movement disorders described in SSPE are dystonic myoclonus, dystonia-parkinsonism, parkinsonism, repetitive behavior, and status dystonicus.[25] Movement

disorders reported in NCL are myoclonus, cerebellar ataxia, chorea, and dystonia.[26] Yıldırım M *et al.* (2021)[27] reported a 5-year-old with NCL who presented with status dystonicus and responded to pharmacological intervention.

The most common infective cause of myoclonus presenting to emergency in our study was SSPE. One elderly male patient had acute onset myoclonus following intake of cinnarizine and prochlorperazine. Sachdev P *et al.* (1996)[28] reported two patients with tics status, who had developed episodes of continual motor tics lasting from minutes to hours, were non-suppressible and intruded into normal functioning. We had a child with tic disorder who presented in tics status and had good response to tetrabenazine.

Implantable pulse generator (IPG) is a waveform generator and power source of DBS. DBS IPG depletion in PD is known to cause akinetic crisis (parkinsonism-hyperpyrexia syndrome) or malignant STN-DBS withdrawal syndrome. Rajan R *et al.* (2016)[29] reported two cases of malignant STN-DBS withdrawal syndrome due to IPG depletion. Similarly, Holla VV *et al.* (2020)[30] reported two patients of PD with bilateral STN-DBS with worsening of symptoms due to IPG depletion. We report two cases of STN-DBS in PD with acute parkinsonism due to IPG depletion.

SS is characterized by increased serotoninergic activity in the nervous system and commonly associated with the use of selective serotonin reuptake inhibitor (SSRI) class of drugs (14% to 16% of SSRI overdose cases). It presents as behavioral changes, motor hyperactivity, pupillary dilation, salivation, flushing, hypertension, myoclonus, and seizures.[2] Our patient had features of SS following increase in the fluoxetine dosage. NMS presents within 4 weeks of exposure to antipsychotics with altered mental status, hyperthermia, rigidity, and dysautonomia.[9] Our patient had symptoms of NMS following initiation of olanzapine.

Strengths of the study

Our study has provided a profile of various movement disorders that can present as neurological emergencies and their etiology. The data present an interesting cross-section of MDE's in India.

Limitations of the study

The limitation was the possibility of referral bias as the study center is a tertiary care center for neurological disorders. Antipsychotic-induced acute onset MD may have been missed as they are admitted to the psychiatry emergency room. Also, the functional movement disorders were directly seen in psychiatry emergency room after triage so those were not reported in our study. Due to the Coronavirus disease 2019 pandemic, there was reduction in the hospital emergency visits of the patients and may have contributed for the reduced final number of recruited patients.

Conclusion

Our study brings out some novel findings on the MDE in Indian scenario. We found chorea as the most common MD. Hyperglycemic hemichorea as the most common etiology of chorea followed by stroke presenting in an emergency service. Dystonia, myoclonus, and acute parkinsonism were the other MDs presenting as emergencies in adults. In pediatric population, dystonia, chorea, and myoclonus was the most common MDE. The data of this study would help to strategize and prioritize the neurology emergency management training and infrastructure that would in turn be beneficial to such patients.

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Conflicts of interest

There are no conflicts of interest.

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Supplementary Table 1: Comparison with other published studies on movement disorders emergencies

	Present study	Dallacchio *et al*. (2018)
Year	2019-2021	2013-2017
Sample size	71	96
Mean age (years)	45.4	52.8
Age range (years)	3-86	15-87
Gender (M: F)	40:31	44:52
Hyperkinetic movement disorder (%)	91.5	73.6
Commonest movement disorder emergencies (*n*/%)	Chorea (42/59.2) Dystonia (11/15.5), Myoclonus (7/9.9), Acute parkinsonism (4/5.6) Dyskinesia (2/2.8) Opsoclonus-myoclonus syndrome (*n*=1) Serotonin syndrome (*n*=1), Dystonic tremor (*n*=1), Tics status (*n*=1) Neurolept malignant syndrome (*n*=1)	Tremor (19/19.8) Myoclonus (17/17.7) Dystonia (15/15.6) Chorea (11/11.4)
Etiology (*n*/%)	Hyperglycemia (18/25.4), Stroke (9/12.7), Infection (7/9.9), Autoimmunity (10/14.1) Infection-induced autoimmunity (2/2.8), Drug induced (9/12.7), Metabolic (3/4.2), Genetic (2/2.8), Etiology not known (9/12.7)	Drug-induced (28/29.2) Psychogenic (19/19.8) Neurodegenerative disease (15/15.6) Brain lesion (11/11.5) Others (23/24.0) -Metabolic (*n*=8), -Dysimmune/inflammatory (*n*=7), -Infective (*n*=6), -Undetermined (*n*=2)
Outcome (*n*/%)	Improved (41/57.7), Status-quo (28/39.4) Worsening (2/2.8)	Complete recovery (47/49.0), Partial recovery (33/34.4), Unchanged (12/12.5) Death (4/4.2)

Supplementary Table 2: Comparison with other published studies on pediatric acute movement disorders

	Present study	Raucci *et al*. (2018)	Dale *et al*. (2010)	Goraya (2015)
Year	2019-2021	2013-2017	2006-2009	2010-2014
Sample size	15	256	52	92
Mean age (years)	10.2	6.3	6.5	4.9
Age range	3-17 years	2 months-17 years	2 months-15 years	5 days-15 years
Gender (M:F)	9:5	149:107	21:31	63:29
Hyperkinetic movement disorder (%)	100	100	80.8	96.7
Commonest movement disorder emergencies (*n*/%)	Dystonia (5/33.3) Chorea (4/26.7) Myoclonus (3/20) Dyskinesia (*n*=1) Tics (*n*=1) Opsoclonus myoclonus syndrome (*n*=1)	Tics (114/44.5) Chorea (35/13.7) Tremors (53/20.7) Dystonia (27/10.5), Myoclonus (16/6.2) Stereotypies (11/4.3)	Chorea (20/38.5) Dystonia (17/32.7) Tremors (12/23.0) myoclonus (10/19.2) Acute parkinsonism (10/19.2)	Myoclonus (25/27.0) Dystonia (21/23.0) Choreoathetosis (19/21.0) Tremors (15/16.0) Acute parkinsonism (3/3.2)
Etiology (n)	Autoimmune (*n*=5) Infection (*n*=2) Infection-induced Autoimmune (*n*=2) Metabolic (*n*=2) Drug-induced (*n*=2) Genetic (*n*=1) Etiology not determined (*n*=1)	Inflammatory (*n*=45) NMDA-R (*n*=3) SC (*n*=36) PANDAS (*n*=4) OMS (*n*=2) Non-inflammatory (*n*=80) Primary dystonia (*n*=10) tremors (*n*=30) Metabolic diseases (*n*=4) Undiagnosed myoclonus (*n*=6) Drug/toxins (*n*=7) Cerebral tumor (*n*=1)) Neuropsychiatric (*n*=131) Tic disorders (*n*=110) Isolated stereotypies (*n*=5)	Inflammatory (*n*=22) NMDA-R encephalitis (*n*=5) OMS (*n*=4) SC (*n*=3) SLE (*n*=3) ANE (*n*=3) Other encephalitis (*n*=3) Non-inflammatory (*n*=18) Drug induced (*n*=7) Postpump chorea (*n*=5) Metabolic (*n*=3) Vascular (*n*=2)	Inflammatory (*n*=32) Encephalitis (*n*=11) OMS (*n*=7) SC (*n*=6) ADEM (*n*=3) Tetanus (*n*=3) Postinfectious tics (*n*=2) NMDA-R encephalitis (*n*=1) Non-inflammatory (*n*=56) Metabolic/nutritional (*n*=25) Physiological (*n*=17) Drug/toxins (*n*=4) Vascular (*n*=1) Traumatic brain injury (*n*=2) Cryptogenic (*n*=2) Ataxia-telangiectasia (*n*=1)