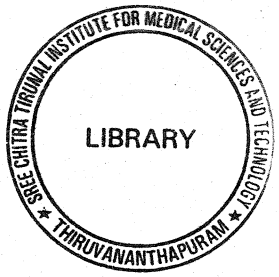
GUILLAIN-BARRE SYNDROME (GBS)IN CHILDREN
A RETROSPECTIVE ANALYSIS

PROJECT REPORT



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PROJECT REPORT

Title of the Project:Guillain-Barre syndrome in children-A retrospective analysis

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Programme: DM Neurology

Month & Year of Submission: November 2001.

CERTIFICATE

I, **Dr Rajesh R** hereby declare that I have actually carried out the project **Guillain-Barre syndrome in children-A retrospective analysis**, under report

Signature

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15.11.2001

Forwarded.

He has carried out the above mentioned project in the department of Neurology, SCTIMST, Thiruvananthapuram

Signature

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Dr Rajesh R

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INTRODUCTION

INTRODUCTION

The Guillain-Barre syndrome (GBS) is characterized as an acute, symmetrically progressive, inflammatory polyneuropathy. GBS occurs at all ages. GBS is now the most common cause of acute neuromuscular paralysis with an annual incidence of 0.8 cases per 100 000 in populations < 18 years. Approximately two-thirds of all cases are preceded by an infection; often the infectious process is nonspecific, however, such as a mild respiratory infection or diarrhea. The clinical criteria proposed by Asbury and Cornblath are generally accepted as the guideline for diagnosing GBS. The two most helpful investigations in GBS are cerebrospinal fluid(CSF) examination and nerve conduction studies. Gulllaine, Barre and Strohl were the first to draw attention to the phenomenon of albuminocylological dissociation. Cornblath et al in 1990 proposed the electrophysiological criteria for demyelination. The course in children may be slightly different from that in adults, in that children recover in a shorter time. Some found no relationship between clinical disability at any point and age, sex , rate of clinical progression, cerebrospinal fluid abnormalities, or degree of conduction slowing In contrast, several studies indicated that patients with abnormal conduction velocities but normal CMAP amplitudes have a better prognosis. In children only two studies are available on the use of plasma exchange in GBS. Efficacy of Intravenous immune globulin(IVIG) in GBS has been established in adults by many studies. Reisin et al had demonstrated the efficacy of IVIG in 13 patients of childhood GBS.In this study 55 cases of childhood GBS(2-18 years) were analyzed retrospectively to study the clinical profile with special emphasis on the nerve conduction studies. Need for ventilation and functional outcome in relation to reduced compound muscle action potential was also studied.

AIMS

AIMS OF THE STUDY

1. To study the clinical profile of children under 18 years of age with GBS.
2. To evaluate the prognostic value of electrophysiological study on the outcome.

REVIEW OF LITERATURE

Early History

Although acute ascending paralytic illnesses have been recognized for centuries, and indeed a reasonable description of what we now call GBS was offered in 1892 by Osier[1], the critical features of the illness were not fully synthesized until after the advent of diagnostic lumbar puncture near the turn of this century. In 1916, Guillain, Barre, and Strohl [2] published a report in the October 13 issue of the Bulletin of the Society of Medicine of the Hospitals of Paris. These authors, working in the neurological center of the French Sixth Army, described two infantrymen . An approximate translation of the opening sentence is: "We bring to attention in the present note a clinical syndrome that we have observed in two individuals, a syndrome characterized by motor difficulty, abolition of deep tendon reflexes with preservation of cutaneous reflexes, paresthesias without demonstrable objective sensory loss, pain on deep palpation of large muscles, minor modifications in electrical reactions of nerve and muscle, and increased albumin in the cerebrospinal fluid with, most notably, absence of cellular reaction (albuminocytological dissociation)." In this single sentence, Guillain, Barre, and Strohl captured the critical elements of the illness. The name of Strohl in time disappeared from the eponym[3]. Bradford, Bashford, and Wilson [4] reported 30 patients with the disorder in 1918 in a report entitled, " Acute infective polyneuritis". In this report, they claimed to have isolated an organism transmissible into other primates. Their claim of infectivity was retracted the following year, but the name" acute infective polyneuritis" took years to fall into disuse. Many, if not most, writers speculated for the next 40 years that the syndrome of Guillain and Barre had either an infectious or a 'toxic basis, Occasionally theories of an allergic basis were put forward.

The Guillain-Barre syndrome (GBS) is characterized as an acute, symmetrically progressive, inflammatory polyneuropathy.

Age Distribution

GBS occurs at all ages. GBS is now the most common cause of acute neuromuscular paralysis with an annual incidence of 0.8 to 3.2 cases per 100 000 in populations < 18 and> 60 years, respectively.[5]. It occurs throughout the world and affects men more commonly than women by a ratio of 1.5:1.All ages are affected, with the oldest patient on record being 95 years old[6]. Cases are said to be uncommon below the age of 2 years[7]There is a slight bimodal age distribution with peaks in-young adulthood and in the elderly. There is no seasonal preponderance ,although summer epidemics of an acute motor axonal neuropathy (AMAN) have been well documented in children from rural areas of China.[8].

Predisposing Factors

Approximately two-thirds of all cases are preceded by an infection; often the infectious process is nonspecific, however, such as a mild respiratory infection or diarrhea[6]. A large number of organisms have been described in association with subsequent GBS, but the most common are Campylobacter jejuni[6], Mycoplasma pneumonia[9]],Cytomegalovirus[10], Epstein-Barr virus[11]and HIV[12]. The onset of neuropathic symptoms typically occurs 1-3 weeks after the infection suggesting that GBS is due to an aberrant post infectious immune response rather than to a direct effect of the infecting agent[6].

Surgical procedures, malignancies(particularly Hodgkin's disease and other lymphomas) and trauma are predisposing events in a small percentage of patients, certainly less than 2

or 3 percent[6,13]. With the exception of specific flu vaccines, such as rabies and swine flu vaccines, modern vaccines have had little, if any, association with GBS[13]. Most cases are sporadic although outbreaks have been described, the largest affecting 16 patients in Jordan who developed GBS after an outbreak of acute waterborne diarrhea[6]

Clinical Manifestations

The fully developed syndrome is easily recognizable, yet diagnostic difficulty occurs in the initial stages because. Of the variable clinical presentations and the wide differential diagnosis (see table).

Table of Differential diagnosis of Guillaine Barre syndrome[6]

Functional	Hysterical conversion
Central	Brainstem infarct
	Brainstem encephalitis
	Acute transverse myelitis/cord compression
	Cauda equina compression
	Poliomyelitis
Neuropathy	Acute intermittent porphyria
	Vasculitic neuropathies, eg SLE. PAN
	Toxic neuropathies. E.g. lead poisoning, alcohol
	Diphtheria
	Lymphomatous infiltration of nerve roots
Neuromuscular junction	Acute myasthenia gravis, Botulism
Muscle	Acute polymyositis
Metabolic	Hypo/hyperkalaemia, hypophosphataemia

Abbreviations: PAN = polyarteritis nodosa: SLE = systemic lupus erythematosus.

GBS typically begins with paraesthesia in the tips of the fingers and toes. Sensory symptoms may then gradually ascend and are often out of proportion to any signs that

may be elicited. Pain is another common presenting complaint and usually occurs in the shoulders, thighs or lumbar region. The pain is probably due to a radiculoneuritis and may be severe. For this reason, GBS may initially be mistaken for an acute musculo-skeletal problem particularly in children who are less able to localize pain[6].The reported incidence of sensory symptom in the pediatric age group ranged from 20% to 25%[14,15]. The clinical criterion proposed by Asbury and Cornblath[16] is generally accepted as the guideline for diagnosing GBS.

1.Features required for the diagnosis

A. Progressive motor weakness of more than one limb

B. Areflexia. Universal areflexia is the rule, though distal areflexia with definite hyporeflexia of the biceps and knee jerks will suffice if other features are consistent.

2. Features strongly supportive of the diagnosis

A. Clinical features

1.Progression. Symptoms and signs of motor weakness develop rapidly but cease to progress by four weeks into the illness. Approximately 50% will reach the nadir by 2 weeks,80% by three weeks, and more than 90% by four weeks.

2. Relative symmetry. Symmetry is seldom absolute, but usually, if one limb is affected, the opposite as well.

3. Mild sensory symptoms or signs.

4. Cranial nerve involvement. Facial weakness occurs in approximately 50% and is frequently bilateral. Other cranial nerves may be involved, particularly those innervating the tongue and muscles of deglutition, and sometimes the extra-ocular motor nerves.

5. Recovery. It usually begins two to four weeks after progression stops. Recovery may be delayed or months.

6. Autonomic dysfunction. Tachycardia and other arrhythmias, postural hypotension, hypertension and vasomotor symptoms, when present, support the diagnosis.

7. Absence of fever at the onset of neuritic symptoms.

Variants

1. Fever at the onset of neuritic symptoms.
2. Severe sensory loss with pain.
3. Progression beyond 4 weeks.
4. Cessation of progression without recovery.
5. Sphincter dysfunction(transient)
6. Central nervous system involvement as ataxia, extensor plantar response and ill defined sensory level.

B. Cerebrospinal fluid features strongly supportive of the diagnosis

1. CSF protein. After the first week of symptoms, CSF protein is elevated or has been shown to rise on serial lumbar punctures.
2. CSF cells. Counts of 10 or fewer mononuclear leukocytes/c.mm in CSF.

Variants

1.No CSF protein rise in the period of 1-10 weeks after the onset of symptoms.(rare)

2.Counts of 11-50 mononuclear cells/c.mm in the CSF.

C. Electrophysiological features strongly supportive of the diagnosis.

3. Features casting doubt on the diagnosis

1.Marked persistent asymmetry of weakness.

2. Persistent bladder or bowel dysfunction.
3. Bladder or bowel dysfunction at the onset.
4. More than 50 mononuclear cells/c.mm in the CSF.
5. Presence of polymorphonuclear cells in the CSF.
6. Sharp sensory level.

4.Features that rule out the diagnosis

1. A current history of hexacarbon abuse.
2. Abnormal porphyrin metabolism.
3. A history or finding of recent diphtheria infection.
4. Features clinically consistent with lead neuropathy and evidence of lead intoxication.
5. The occurrence of a purely sensory symptom.

6. A definite diagnosis of a condition such as poliomyelitis, botulism or toxic neuropathy.

One of the 2 features required for the diagnosis of GBS progressive weakness of all4 limbs. This is characteristically ascending and relatively symmetrical. It may be predominantly proximal, predominantly distal or equally proximal; and distal. The reported incidence of motor weakness as the presenting symptom varied from 75-95%[7,15]. 25% of patients will have severe respiratory muscle weakness requiring mechanical ventilation. Generally 10-25% of children needed ventilation[7].The highest incidence reported was 29% by Kleyweg et al[17] and the lowest of 5 % by Hart et al[15]. Facial weakness occurs in one-third of patients and in severe cases eye movements are affected[6] The incidence of facial weakness in childhood GBS is generally 21-52%[7,14,15,18].The usually quoted figure for bulbar involvement is 29-35% in the above series There may also be bulbar weakness either as part of a generalized picture. or as the presenting symptom of 'upside down'.GBS in which weakness descends rather than ascends. This clinically manifests as dysphagia, dysarthria and drooling of saliva when there is severe weakness of swallowing.. Ocular involvement is generally 9-17%[7,19] Hyporeflexia or areflexia is the other feature required for the diagnosis of GBS, although reflexes may be preserved in the first few days of the illness .Complete areflexia is the rule even if weakness is relatively mild and persists long after strength has returned.

GBS is a heterogeneous condition. The extent of disability ranges from the mildest cases characterized by some difficulty walking and climbing stairs to the most severe cases where there is an explosive onset and a rapid progression to tetraplegia within the first 24 to 48 hours[6]

Investigations

The diagnosis of GBS is a clinical one and relies on a history of symmetrical weakness and areflexia commonly following an infection.

The two most helpful investigations in GBS are **cerebrospinal fluid(CSF)** examination and **nerve conduction studies**. Gulllaine, Barre and Strohl were the first to draw attention to the phenomenon of albuminocylological dissociation[2], whereby the ,CSF protein is elevated without a concomitant CSFpleocytosis. This occurs in about 90% of patients, although the protein is often normal in the first week[6]. Therefore a negative CSF examination in the the early days of the disease does not exclude the diagnosis. Hart et al[15] had reported a raised protein level in 64%.But other series noted higher percentages(Paulson –89%[7] and Epstein-93%[19])..A raised CSF white cell count of more than 10/c.mm is unusual and is suggestive o HIV infection in which GBS may occur as part of a seroconversion illness[6].

Criteria for Peripheral Nerve Demyelination

Many investigators .have dissected the correlates of nerve conduction studies and nerve disease, most notably Dyck and Lambert at the Mayo Clinic [20], BuchthaI and Behse in Copenhagen[21], and Cragg and Thomas [22]. Despite these achievements, no clear consensus has existed as to the detailed criteria required to determine whether a nerve conduction study provides evidence of demyelination. In 1983, Kelly [23] summarized the previous data and suggested electrophysiological criteria for a definite diagnosis of peripheral nerve demyelination. To be classified as a demyelinating neuropathy, a nerve conduction study had to have at least three of the following abnormalities: slowing of conduction velocity in two or more motor nerves to less than 60% of the normal mean

value for that nerve; conduction block on proximal stimulation in one or more motor nerves; prolonged distal latency in two or more motor nerves; or F-wave latency abnormally prolonged in one or more nerves.

Cornblath et al in 1990 proposed the following electrophysiological criteria for demyelination[24].

Nerve conduction studies, including studies of proximal nerve segments in which the predominant process is demyelination, must have three of the following four criteria:

1. Reduction in conduction velocity in two or more motor nerves.
(a) Less than 80% of lower limit of normal (LLN) if amplitude is greater than 80% of LLN.
(b) Less than 70% of LLN if amplitude is less than 80% of LLN.

2. Conduction block or abnormal temporal dispersion in one or more motor nerves: Peroneal nerve between ankle and below fibular head, Median nerve between wrist and elbow, or Ulnar nerve between wrist and below elbow.

Criteria for partial conduction block:

(a) Less than 15% change in duration between proximal and distal sites and greater than 20% drop in negative-peak (-p) area or peak-to-peak (p-p) amplitude between proximal and distal sites.

Criteria for abnormal temporal dispersion and possible conduction block:

(a) Greater than 15% change in duration between proximal and distal sites and greater than 20% drop in negative-peak (-p) area or peak-to-peak (p-p) amplitude between proximal and distal sites.

3. Prolonged distal latencies in two or more nerves.

(a) Greater than 125% of upper limit of normal (ULN) if amplitude is greater than 80% of LLN.

(b) Greater than 150% of ULN if amplitude is less than 80% of LLN .

4. Absent F-waves or prolonged minimum F-wave latencies (10 to 15 trials) in two or more motor nerves.

(a) Greater than 120% of ULN if amplitude is greater than 80% of LLN.

(b) Greater than 150% of ULN if amplitude is less than 80% of LLN.

Evolution of Electrophysiology in GBS

.In a 1959 article on childhood GBS from the Mayo Clinic [25], Dr E. Lambert performed the physiological studies and concluded as follows:

Studies of conduction were carried out on the median, ulnar and peroneal nerves. The muscular response to maximal stimulation of these nerves was reduced in magnitude. Often, the response of a muscle was greater when the nerve was stimulated near the muscle than when it was stimulated at a distance from the muscle. Velocity of conduction in the excitable motor fibers of the nerves was normal or slightly reduced in patients examined during the first few weeks of their illness but was definitely below the range of normal values in patients examined eight to fifty weeks after onset of the illness.

This description of the evolution of conduction studies in GBS has not been improved on. This single paragraph contains the major features, including early conduction block, early reduction in distal evoked CMAP amplitude, and a later reduction in motor conduction velocity.

In 1985, Albers and colleagues [26] summarized 180 electro diagnostic studies from 70 patients with GBS. These studies were performed from the onset of the disorder to 50

weeks later. They were able to study the temporal evolution of motor conduction physiological features in GBS. Within 1 week of symptom onset, the mean values for CMAP amplitude from distal stimulation are reduced to about 50% of normal, falling further during the second and third weeks of illness, after which there is slow recovery toward normal values. Examination of similarly analyzed data for mean motor conduction velocity reveals that unlike the motor amplitudes, the mean motor conduction velocities are relatively well preserved early in the disease, falling to about 70% of normal in the third week. The mean values recover toward normal at a much faster rate than those for motor amplitude. Mean F-wave latencies are frequently abnormal but; not until the fourth week of disease. Electromyographic abnormalities, as determined by the presence of denervation potentials, are seen late in the course of GBS. When the criteria for demyelination that Albers and colleagues [26] developed were applied to their patients, 70% had demyelination in two or more nerves, with an additional 15% having demyelination in one nerve, suggesting that demyelination is the predominant electrophysiological finding in GBS.

Cornblath et al [27] have examined the electrophysiological data from 210 of the 245 patients in the North American study of GBS. They found abnormalities of distal motor latency and F-wave latency in about one-half of the patients when first studied. Abnormalities of distal CMAP amplitude, the ratio of the proximal to the distal CMAP amplitudes, and motor conduction velocity were less common. These data support those from previous studies, which suggested that early in the course of GBS, physiological evidence of demyelination primarily occurs proximally and distally along nerve fibers. Only later do conduction velocities in leg and forearm fall into the range usually considered indicative of demyelination [26, 28].

Prognostic Use of Motor Conduction Data

Various investigators have tried to determine if electrophysiological ,data can be used to prognosticate outcome in patients -with GBS. Retrospective studies looking for possible relationships between clinical characteristics, electro diagnostic studies, and prognosis in patients with GBS have provided conflicting conclusions[24]. Some found no relationship between clinical disability at any point and age, sex , rate of clinical progression, cerebrospinal fluid abnormalities, or degree of conduction slowing [29-30]. In contrast, several studies [31-36] indicated that patients with abnormal conduction velocities but normal CMAP amplitudes and the absence of denervation potentials (fibrillations and positive sharp waves) have a better prognosis, as measured by lack of muscle wasting, short hospital stays, increased survival, increased chance of improving, and decreased time on a respirator.

Poor prognosis, as measured by marked muscle wasting, long hospital stays, decreased survival, increased time on a respirator, and residual clinical disability was correlated. with low CMAP amplitudes, prolonged phrenic nerve distal latency, and abnormal spontaneous denervation activity .The variation among results reflects the retrospective nature of the studies, the relatively small numbers of patients, the varying and sometimes vaguely defined measures of outcome, and the fact that other factors now known to be important predictors of outcome-age, prior length of illness, and respirator status [37]-were not taken into consideration.

In the North American study of plasmapheresis in GBS, standardized electro diagnostic testing was performed within the first 30 days of illness in 210 of the745 patients. To determine the relation to outcome, Cornblath et al [27] analyzed the prospectively

collected motor conduction data obtained during the first 30 days of illness. In univariate analysis, mean CMAP amplitude from distal (distal CMAP amplitude) and proximal stimulation and mean motor conduction velocity were related to four predetermined outcome measures. In multivariate analysis of the motor conduction parameters, mean distal CMAP amplitude was the single variable that best predicted prognosis; other measures did not add to its predictive value. In further multivariate analysis of all factors relating to outcome, mean distal CMAP amplitude was determined to be the most powerful predictor of outcome followed by plasmapheresis [37]. These two factors were always statistically significant over and above all other variables. These results indicate that prognostic information can be obtained from motor conduction studies performed early in the course of GBS; a mean distal CMAP amplitude of 0 to 20% of LLN is associated with a markedly increased probability of a poor outcome. Nevertheless, even in patients with a low mean distal CMAP amplitude, the predicted outcome improves with plasmapheresis therapy. Physiologically, a low CMAP amplitude occurs because the number of functioning motor axons with secure conduction to their respective functioning muscle fibers is reduced [24]. This complex system may fail at a number of sites. The two most plausible explanations in patients with GBS are either a demyelinative lesion in the distal or preterminal internodes or a loss of motor axons. The latter explanation is most likely; loss of motor axons would result in a poor prognosis, because recovery would require successful axonal regeneration[24].

Antibodies against ganglioside GQ1 b[38] be helpful in diagnosing Miller Fisher syndrome.Ig G antibodies against gangliosideGM1 occur in 2 0 to 30% of patients and are associated with a poor prognosis[39]

Course of the Disease

Classic GBS has an acute onset, that is, a patient can have acute onset of minor sensory changes, such as a dysesthesia in the hands or feet, followed by rapidly ascending weakness. The devastating acute course may take a person from being absolutely normal to being bedridden and on a respirator within 2 or 3 days. In the classic presentation, the progression usually occurs over 10 to 12 days before a plateau is reached, followed by a gradual recovery. However, the recovery can be almost as dramatic as the onset.Some patients have a stuttering onset in which the disease has a period of progression, remains on a plateau, progresses again, and goes through a series of similar stages before reaching the nadir of involvement. The same events may occur during the recoveryPhase[13].

Lastly, some patients have a sub acute onset with a rather slow progression that can take place over a few weeks. This latter group is difficult to distinguish from a group of patients classified as having chronic inflammatory demyelinating polyneuropathy (CIDP). At present, however, it is generally accepted that GBS and CIDP are distinguished at least in part by the pattern of onset[13].

Prognostic Factors

The 245 patients enrolled in the North American study of the efficacy of plasmapheresis [40] provided an opportunity to analyze factors that influence outcome. Five factors were identified: age, requirement for respiratory support, rate of progression, abnormal physiological characteristics of peripheral nerve function, and plasmapheresis [37]. Physiological dysfunctions included summed motor velocity less than 80% of normal, summed proximal motor amplitude less than 20% of normal, and summed distal motor amplitude less than 20% of normal, all of which were associated with poor outcome.

Summed distal motor amplitude had the strongest correlation. The only one of these factors that a physician can influence is the use of Plasmapheresis. There was no correlation with sex, occupation, or a the presence of diabetes, previous steroid usage, prior infection, prior immunization, or prior operation.

The outcome in untreated patients is unpredictable. A small percentage has very little recovery at all. Other patients undergo a gradual recovery , but many are left with residual symptoms such as facial weakness, weakness of the lower extremities with foot drop, weakness and atrophy of the hands, and autonomic dysfunctions such as urinary retention or impotence. Thus, although it is impressive to see patients who have been virtually paralyzed and on respirators make gratifying recoveries so that they are able to bear weight, stand, and then walk unaided, the ultimate out come often includes various neurological residua. In addition, the time to recovery can be quite prolonged. For those patients in the North American study of the effect of plasmapheresis [40] who were in the control arm, the median time to recovery of independent walking for all patients was 85 days; for those who had been on a respirator, the median time was 169 days. Disability scale used in major treatment trials was adapted from Hughes et al[41]

Grade	**Definition**
0	Healthy, no symptoms or signs due to GBS
1	Minor symptoms or signs and capable of running
2	Able to walk 5 M across an open space without assistance, walking frame or stick, but unable to run
3	Able to walk 5 M across an open space with the help of 1 person or walking frame or stick
4	Bed bound or chair bound
5	Requiring ventilatory assistance
6	Death

The course in children may be slightly different from that in adults, especially in relationship to older adults, in that children recover in a shorter time [42,43]. A study by Epstein and Sladky [19], comparing. time and independent walking in a pediatric population with the control arm of the North American study [40], indicated that children walked at 52 days and adults at 85 days. There is an unusual situation in northern China in the provinces of Hebei, Shandong, and Shanxi, where summer epidemics of a GBS like illness occur in young children with a peak age of 4 to 6 years and in young adults. These epidemics are found in the rural areas of the provinces, and the disease has many of the clinical characteristics that we associate with GBS. There are some differences in that these children have more involvement of musculature innervated by lower cranial nerves, particularly cranial nerves 7, 9, 10, and12 [44]. Hence, it is not unusual to see a young child with a tracheostomy in place during the recovery phase-not because of respiratory failure but because the child is still having great difficulty with swallowing. In Kleyweg's[17] series 83% of children were ambulant without support at 12 months. All the 23 children in Epstein's series[19] attained stage 2 at 6 months. The reported complete recovery was 73% in the Paraguan series[15].

The prognostic value of electro physiology in childhood GBS has been rarely evaluated[45].Bradshaw et al in a retrospective study of childhood GBS indicated that the presence of a low CMAP amplitude of less than 20% of the lower limit of the normal was not useful prognostically[46]. On the contrary Reisin et al[47]had demonstrated that children with GBS and low mean CMAP amplitude or in excitable nerves had a more severe disease, and slow recovery.

Ropper AH et al [48] compiled the major series of childhood GBS from 1958 to 1987 and of the total of 344 children 14 died and 143 made a complete recovery.

Management

General Measures[6]

The essential features of good general management are careful observation of cardio-respiratory function, prevention of complications due to prolonged immobility, analgesia and continual reassurance that complete recovery is the rule. It is mandatory to monitor the respiratory muscle strength. The most convenient bedside measurement is the vital capacity(VC). Patients should be transferred to an intensive care unit(ICU) if the VC falls below 20 ml/kg The patient should be electively intubated if he/she shows signs of impending respiratory failure, i.e. he/she appears tired, is tachypnoeic and tachycardic and has paradoxical respiratory movements. The. Other indication for elective ventilation is severe bulbar palsy where the patient is having swallowing saliva. This is best monitored by looking for pooling of saliva and a post-swallow cough.

In view of the frequency and seriousness of autonomic complications in GBS, all patients should have their ECG monitored continuously from diagnosis until they are in the recovery phase. Sinus tachycardia is common and generally does not require treatment; bradycardias, however, should be treated with atropine and may be related to tracheal toilet. Preoxygenating the patient before suction can prevent them. Severe cases of complete heart block or sinus arrest are rare, but require the insertion of a temporary endocardial pacemaker.

Labile blood pressure should be treated with small doses of beta-blockers (hypertension) or colloid and head down tilt (hypotension).

GBS patients arc often paralyzed for many weeks and are therefore susceptible to the complications of prolonged immobility, in particular hypostatic pneumonia, sepsis, decubitus ulcers, contractures and venous thromboembolism. The risks of these can be reduced by optimal positive pressure ventilation, chest physiotherapy, suctioning of secretions, broad spectrum antibiotics when clinically indicated, regular turning and ripple mattresses, passive joint movements and subcutaneous heparin . A tracheostomy should be fashioned if the patient requires ventilation for more than 10 to 14 days as it is more comfortable than an endotracheal tube and less likely to produce a tracheal stricture. Urinary retention is uncommon, but catheterization is often performed for the convenience of the nursing staff when the patient is tetraplegic. The gastrointestinal tract may be affected by an autonomic neuropathy giving rise to constipation and ileus. Death may rarely occur from caecal or colonic perforation. To prevent these complications, patients should be given regular laxatives and enemas as necessary. Nasogastric feeding should be stopped once an ileus has developed, and a prokinetic agent, e.g. cisapride, used to stimulate gut motility.

Patients with GBS require nasogastric feeding if they have a bulbar palsy or if they are being ventilated by an endotracheal tube. This should be started as early as possible because there is often a hypercatabolic state and marked loss of muscle bulk. Pain is a frequent problem in GBS and may be due to a number of factors, e.g. radiculitis, neuritis, muscle aches due to immobility and hyperpathia. Standard analgesics, e.g. paracetamol,

paracetamol-dextropropoxyphene and non-steroidal anti-inflammatory drugs, are useful if the pain is mainly musculoskeletal.

Finally attention must be paid to the psychological aspects of patient care. Ventilated patients are unable to speak and will only be able to communicate verbally once they have a tracheostomy and can use an electronic voice transducer: Therefore nonverbal cues, mime actions, the use of alphabet boards and written messages form the only means of communication with staff and visitors for many weeks. When communication is so difficult and paralysis so severe that even simple movements such as scratching are impossible, it is not surprising that patients become rapidly frustrated. They may feel that they will never recover and always be dependent on others. They may be suffering pain and discomfort, which are difficult to control, and they may also have visual hallucinations, particularly when in the ICU where sleep patterns are disrupted. Depression is common and should be recognized early and treated appropriately. Tricyclics are often used for neuropathic pain as well, and amitriptyline is particularly useful when insomnia is a problem as it has sedative properties and can be given as a single nighttime dose. All medical, nursing and other staff should adopt a consistent policy of encouragement and reassurance that the patient is likely to make a full recovery despite the very slow progress.

Specific Treatments

Plasmapheresis and GBS

Plasmapheresis is now the accepted therapy for GBS. The efficacy of this therapy has been demonstrated in three controlled studies [40, 49,50]. The North American GBS-study [40] and the French Cooperative Group study [50] each analyzed more than 200 patients.

Safety of Plasmapheresis

When plasmapheresis was initially instituted, a major question was whether it was safe for severely ill patients. In the North American study [40], about 40% of the patients were paralyzed and required artificial ventilation. The complications observed in the patients treated with plasmapheresis versus the conventionally treated group were similar and showed no substantial differences. Moreover, there was no increase in the number of deaths associated with plasmapheresis. The French study obtained similar results.

Efficacy of Plasmapheresis

The North American and French studies clearly demonstrated that plasmapheresis shortens the time to achieve independent walking, the time a patient stays on a respirator, and the time it takes for a patient to improve one grade on the standardized grading scale, as well as increasing the percentage of patients showing improvement at 1 month and 6 months [40,49,50]. In addition, at 6 months, there was a notably lower percentage of residual neurological involvement in patients in the plasmapheresis group compared with those in the control group [40].In children only two studies are available on the use of plasma exchange in GBS .Between 1987 and 1989 Lamont et al [18] plasmapheresed 6 children with GBS. None of the children could walk independently at the start of the treatment, and one was being ventilated. Five patients showed improvement during pheresis, and no significant side effects occurred. The median time from onset of weakness to independent walking for these 6 children was 17 days. This compares with 43 days for 18 children with GBS in their institution who were given supportive measures only. Similar results were obtained by Epstein et al [19] also. In their group of 23 children with GBS, 9 underwent plasmapheresis and 14 served as historical controls. The mean time to recover to Grade 2

was significantly shorter in the plasmapheresis treated group,24 days, compared to 60.2 days in the control subjects.

Efficacy of **Intravenous immune globulin(IVIG)** in GBS has been established in adults by many studies[51,52,53]. Reisin et al[45] had demonstrated the efficacy of IVIG in 13 patients of childhood GBS.

METHODOLOGY

METHODOLOGY

This retrospective study was undertaken in Sree Chitra Tirunal Institute for Medical Sciences and Technology(SCTIMST),Trivandrum,South India, which is a tertiary referral center for Neurological and Cardiological diseases.

INCLUSION CRITERIA

Children under the age of 18 years treated in SCTIMST between June 1994 and June 1999 with the diagnosis of GBS were studied.

EXCLUSION CRITERIA

1. Children with other significant medical co-morbidities, which interfered with staging of illness.
2. Children under the age of 2 years.
3. Children who did not attain independent walking premorbidly.

CHART REVIEW

The charts of the eligible patients during the above mentioned period were reviewed .For clinical diagnosis Asburry's clinical criteria[16] was used.

The onset symptoms ,the date of onset of the illness and the history of preceding infections in the previous 4 weeks were specifically looked into. The clinical picture at peak deficit was used to for analysis of the clinical pattern. Children were staged according to the Modified Hugh's Staging[41] both at the day of admission as well as on the day of peak deficit.

Data about the patients who required assisted ventilation was noted separately with emphasis on the indication for ventilation, day of beginning of ventilation and the duration of ventilation.

CSF parameters like cell count and protein level with regard to the day of illness were also studied.

Motor nerve conduction study was reviewed systematically and the Cornblath Criteria[24] were applied to the test values for calculation. Motor distal latencies, velocities, conduction block, F wave latency and the compound muscle action potential(CMAP) amplitudes were analyzed separately in the median, ulnar, and peroneal and posterior tibial nerves. The lower limit of normal for CMAP amplitude was arbitrarily chosen as 5 mV in all the nerves. For calculating the motor conduction velocity pediatric normative data was referred to[54]. Expected height for the age and sex[55] was used for obtaining the F wave latency[56]. Conduction block was defined as 50% or more drop in the CMAP amplitude on proximal stimulation . Also the conduction pattern in the first week of illness was studied separately.

Follow up data at 3,6 and 12 months were noted and the parameter looked into was the ability to walk independently i.e., at least stage2. Relation between reduced CMAP amplitude(at least 2 nerves showing less than 20% reduction below the lower limit of the normal) and the functional outcome was specially verified.

STATISTICAL ANALYSIS

Chi-Square(X 2) test[57] was used to analyze the association between reduced CMAP amplitude and the functional outcome at 3 and 6 months and also the need foe ventilation .Effect of IVIG on the mean duration of ventilation was analyzed by t-test

RESULTS

RESULTS

55 children were found eligible during the study period. The sex distribution was equal in the study population,28 boys and 27 girls. The age distribution was as shown in **Table 1**

Table 1

Age	**Boys**	**Girls**	**Total**
2-5 years	8	9	17
6-10 years	8	9	17
11-15 years	9	5	14
>15 years	3	4	7
Total	**28**	**27**	**55**

The onset was with sensory symptoms in 27 children and in 19 of them it was pain in the legs(**Table 2**).2 patients had numbness and 6 described paresthesia at the onset. All the 8 children who described numbness or paresthesia were above the age of 10 years. The onset was with limb weakness in 26 children and with bulbar weakness in the rest 2.

Table 2

Onset symptom		**Number of children(%)**
Sensory		
Pain		19(34.5)
Numbness/Paresthesia		8
Weakness		
Limb		
	Lower limbs	24(43.6)
	Upper limbs	0
	Both limbs	2
Bulbar		2

History of preceding infection was available in 50 patients. The commonest preceding infection in the previous 4 weeks was upper respiratory tract infection in 18 children. Nonspecific febrile illness was present in 6 and diarrhea in 4 children. Serology for

Campylobacter jejuni was not done. In 22 children there was no history of a preceding infection(**Table3**).

Table 3-History of infection in the previous 4 weeks

History of infection	**Number of children(%)**
Present	28(56)
Upper respiratory infection	18(36)
Nonspecific febrile illness	6
Diarrhea	4
Absent	22(44)

37 patients were admitted within 7 days after the onset of the illness and only 5 patients came after the first 2 weeks(>14 days).

On the day of admission all the patients were in at least stage2 of the illness(**Table4**).More than 60% of the patients were in stage 4.

Table 4 –Stage of the illness at admission

Stage	**Number of children(%)**
2	3
3	6
4	34(61.8)
5	12
Total	**55**

Clinical features at the peak deficit were analyzed. Ocular involvement was very rare; being present only in 2 patients. Nearly 75% had bifacial weakness. All the children had limb weakness. Areflexia was a common finding. Biceps, Supinator, Triceps, Knee and Ankle jerks on both sides(total sites) were included for analysis. Areflexia in at least 4

sites were present in 52(94.5%) cases. None of the patients had totally normal deep tendon reflexes.

48(87.3%) patients were in stage 4 or 5 at the time peak deficit. At the time of admission also nearly an equal number of children(46) were in stage 4 and above. But the number of patients who became stage 5 subsequently was almost double(12 and 23 respectively).There were no deaths in the study group.

Of the 23 children who required assisted ventilation, the indication for ventilation was respiratory paralysis in 21 cases and in remaining 2 it was because of pneumonia. Most of the children (87%) were ventilated within the first 2 weeks of the illness(**Table 6**).

Duration of ventilation was less than 3 weeks in 78.3% of cases(**Table7**).The maximum duration was 50 days and the minimum 6 days.

Table 5-Clinical features at peak deficit

Clinical sign		**Number of patients(%)**
Cranial nerves affected		
Ocular		2
Bifacial		41(74.5)
Bulbar		24(43.6)
5 th motor		1
Limb weakness		55
Areflexia		
	Total in all 10 sites	32(58.2)
	Only in 4-9 sites	20(36.4)
	Only in 1-3 sites	2
	Nil	1
Hyporeflexia		
	In 4-9 sites	12
	In <4 sites	10

Normal reflexes		
	Total	0
	4-9 sites	2
	1-3 sites	2
Stage at peak deficit		
	2	1
	3	6
	4	25(45.5)
	5	23(41.8)
	6	0
Assisted ventilation		
	Required	23(41.8)
	Indication	
	Respiratory paralysis	21
	Pneumonia	2
	Not required	32(58.2)

Table 6-Day of ventilation

Day of ventilation	**Number of patients**
1-7	10
8-14	10
15-21	2
>21	1

Table7-Duration of ventilation

Days	Number of patients(%)
1-7	4
8-14	8
15-21	6
21-28	1
>28	4

A CSF study was available in 44 patients.37 patients had a total count of less than or equal to 5 cells/c.mm. In the rest 7 patients the count was up to 10/c.mm.In no patient the total count was above 10 /c.mm. All the cells were lymphocytes. Glucose was normal in all the patients. Elevated protein of more than 45 mg% was seen in only 29(65.9%) patients(Table8).

Table 8-CSF study

Day of illness	Total protein content in the CSF in mg%		
	<45	45-100	>100
1-7	5	4	2
8-14	6	8	11
>14	4	0	4
Total	15	12	17

Electrophysiological studies were done in 53 cases. In 22 cases it was done in the first week and in 26 cases in the second week of illness. In 5 cases it was delayed beyond the second week(**Table 9**).The commonest abnormality was abnormal F wave response and reduction in the CMAP amplitude in at least 2 nerves, which were present in 86% and 84.5% of cases respectively .Next frequent abnormality was prolonged distal latency in at

least 2 nerves(72.5%) followed by reduced motor nerve conduction velocity in at least 2 nerves(54%) and conduction block in at least 1 nerve(41.5%).

Table 9-Electrophysiological studies

	Number of patients(%)
Distal latency	
Totally normal	12(23.5)
Prolonged in 1 nerve	2
Prolonged in at least 2 nerves	37(72.5)
Could not be commented	2
Motor conduction velocity	
Totally normal	22(44)
Reduced in 1 nerve	1
Reduced in at least 2 nerves	27(54)
Could not be commented	3
Conduction block	
Nil	30(58.8)
In 1 nerve	8(15.7)
In at least 2 nerves	13(25.5)
Could not be commented	2
F wave latency	
Normal	6(12)
Prolonged/absent in 1 nerve	1
Prolonged/absent in at least 2 nerves	43(86)
Could not be commented	3
CMAP Amplitude	
Normal	6(11.5)
Reduced in 1 nerve	2
Reduced in at least 2 nerves	44(84.6)
Could not be commented	1
CMAP Amplitude Reduction of <20%	
None	24
In 1 nerve	7
In at least 2 nerves	22

The electrophysiological parameters were also analyzed separately in the 22 children in whom the study was done in the first week of the illness (**Table 10**).In this group also the commonest abnormality was abnormal F wave response(90.9%) followed by reduced CMAP amplitude(77.3%) in at least 2 nerves. Incidence of prolonged distal latency (45.5%) and reduced motor nerve conduction velocity(31.8%) was less compared to the whole study group. However the incidence of conduction block was similar both the groups.

Table 10-Electrophysiological study in the first week of the illness

	Number of patients (%)
Distal latency	
Normal	8(36.4)
Prolonged in 1 nerve	2(9.1)
Prolonged in at least 2 nerves	10(45.5)
Motor conduction velocity	
Normal	15(68.2)
Reduced in at least 2 nerves	7(31.8)
Conduction block	
Nil	12(54.5)
In 1 nerve	3
In 2 nerves	7(31.8)
F wave response	
Normal	1
Abnormal in 1 nerve	1
Abnormal in at least 2 nerves	20(90.9)
Reduced CMAP Amplitude	
Nil	4
In 1 nerve	1
In 2 nerves	17(77.3)

Table 11-CMAP Amplitude <20% as an indicator for the need of assisted ventilation

CMAP Amplitude	Needed ventilation	No ventilation	Total
	No:	No:	No:
<20% in 2 nerves	17	27	44
<20% in <2 nerves	4	4	8
Total	21	31	52

p Value= >0.5

Reduction of CMAP amplitude below 20% of the lower limit of normal in at least 2 nerves was taken as an electrophysiological parameter to predict the need for assisted ventilation .But no difference in the incidence of reduced CMAP amplitude in the ventilated and non ventilated group could be seen statistically(**Table 11**).

Out of 55 children 32 patients were given IVIG in a dose of 400 mg/kg body wt X 5 days.19 children were given plasma exchange by the method of small volume exchange. Those patients who could not afford IVIG were managed with plasma exchange. But in many children plasma exchange could not be completed because of intravenous access problem, hypotension, hypoproteinemia or fever. Because of these reasons the volume of plasma removed ranged from 30 to 150 ml/kg body wt. In 4 cases no therapy was given and in this group 3 children were in stage 4 and one in stage 2 at peak deficit.).Of the 22 children who required assisted ventilation 10 children received IVIG. The remaining 12 children received either plasma exchange or no therapy. In the 10 children who received IVIG the mean duration of ventilation was 15.9 days and in the 12 children who did not receive IVIG the mean duration of ventilation was 17.8 days and this difference was not statistically significant(p value 0.7)

Neurological status at 3,6 and 12 months were assed and the stage was ascertained(**Table 12**).At 3 months 65.5% of the patients came for the review; but at 6 months only 47.3 and

at 12 months only 25.5% of the cases turned up. At the time of discharge all the patients were in stage 4 or below. 31% of the patients were in stage 3 or below, compared with the 12.7% at peak deficit. At 3 months 30 (83.3%) out of the 36 children were ambulant without support(stage 2) and the trend was similar at 6 months also(80.8%).Functional outcome at 3 and 6 months for children who received IVIG was analyzed separately though it was not included in the aims. At 3 months 22 of the 27 patients(81.4%) and at 6 months 20 out of the 23 patients (86.9%)were ambulant without support. These figures are similar to the general trend. No statistical conclusion can be drawn from this figures as the number of patients was less.

Table 12-Follow up data

Stage of illness	**At discharge**	**3 Months**	**6 Months**	**12 Months**
0-1	0	16	15	7
2	4	14	5	7
3	13	4	6	-
4	38	2	-	-
Total	55	36	26	14

The prognostic value of reduced CMAP amplitude less than 20% of the lower limit of normal in at least 2 nerves in predicting the functional outcome was assessed using the Chi-Square test .But this did not have any statistically significant prognostic value in predicting the functional outcome of independent walking at 3 or 6 months(**Tables 13A & 13B**).

Table 13A-CMAP Amplitude reduction in relation to functional outcome at 3 months

CMAP Amplitude	**Clinical stage at 3 months**		
	2 or less	**>2**	**Total**
<20% in at least 2 nerves	8	5	13
<20% in less than 2 nerves	22	4	26
Total	30	9	39

p Value= >0.1

Table 13B-CMAP Amplitude reduction in relation to functional outcome at 6 months

CMAP Amplitude	**Clinical stage at 6months**		
	2 or less	**>2**	**Total**
<20% in at least 2 nerves	10	3	13
<20% in less than 2 nerves	19	2	21
Total 29	5	34	

p Value= >0.25

DISCUSSION

DISCUSSION

The study group was homogenous with respect to age and sex distribution.

The commonest symptom at onset was weakness in majority of the children; but pain in the leg/calf was also a significant onset problem in 34.5 % children. Rantala et al[14] had reported the incidence of sensory symptoms in 20% of their pediatric population. This was 25% in the childhood GBS group in Paraguay reported by Hart et al[15].Our study had higher incidence of sensory symptoms at the onset. Since all the children who reported the sensory symptoms were above the age of 10 years, the actual incidence would have been more as 62% of the children were below 10 years of age. Weakness as the presenting symptom was seen in only about 44% of patients. The reported incidence of motor weakness as the presenting symptom varied from 75-95%[7,15].Since the initial sensory symptoms were more, naturally the incidence of onset weakness was less.

History of preceding infection in the previous 4 weeks was high(56%). In the majority it was in the form of an upper respiratory tract infection(URI)(64%).Paulson et al had reported a similar incidence of preceding febrile illness(52%).A similar pattern had been obtained by Hart et al[15] where 54% of children had a preceding infection and commonest infection was URI. Incidence of gastrointestinal infection was 15% in his series. In our series it was 14%.Viral serology or anti-Ganglioside antibodies were not done in the study group.

Majority of the children were in stage 4 or 5 at the time of admission(83.6%).This high incidence of severe disease was because our center is a tertiary care hospital and because of the admission bias.

Bifacial weakness was a common feature present about 75% of the children. The incidence of facial weakness in childhood GBS is generally 21-52%[7,14,15,18].The bulbar involvement was 29-35% in the above series.

In our study bulbar involvement was seen in 56.4% and ocular nerves involvement was present in 3.5% cases. Ocular involvement with the previous series have been 9-17%[7,19].The higher incidence of facial as well as bulbar weakness in our series could be due to the majority of children being in stage 4 and 5.

Areflexia in at least 4 sites was present in 94.8% cases. None of the patients had totally normal deep tendon reflexes. This went in accordance with the Asburry's clinical criteria.

At peak deficit 87.2% children were in stage 4 or 5.At admission this figure was 83.6%.But there were 11 more patients in stage 5 at peak deficit compared to admission. Only 15 patients (27%) worsened by at least I stage after admission. This was probably because of the fact that already more than 80% of the patients were in stage 4 or 5 at the time of admission.

41.8% of patients needed assisted ventilation. Generally 10-25% of children needed ventilation(7).The highest incidence reported was 29% by Kleyweg et al[17] and the lowest of 5 % by Hart et al[15]. The reason for higher percentage of severe disease in our series is already mentioned .Children needed assisted ventilation 10.5 days(mean) after the disease onset. The mean duration of ventilation was 16.9 days(range 6-50 days).In the 10 children who received IVIG the mean duration of ventilation was 15.9 days and in the 12 children who did not receive IVIG the mean duration of ventilation was 17.8 days and this difference was not statistically significant. The mean duration of ventilation reported in

childhood GBS varies from 21.5-25 days[14,17].Compared to these figures our patients required shorter periods of ventilation. There were no deaths in the study group.

CSF analysis was available only in 80% patients. None of the patients had a cellular response of more than 10/c.mm.Elevated CSF protein was present only in 65.9% patients. The highest value obtained was 248 mg%. Hart et al had reported a similar figure of 64%[15].But other series noted higher percentages(Epstein-93%[19] and Paulson – 89%[7]). In the 33 patients in which the CSF analysis was done after the first of illness elevated CSF protein of more than. 45 mg% was seen only in 69.6% cases, which indicated that the results were not tilted by the duration of the illness.

Electrophysiological study was available in 53 cases. The commonest abnormality detected was abnormal F wave latency(86%) followed by reduced CMAP amplitude(84.6%),both in at least 2 nerves Other abnormalities in decreasing order of incidence were prolonged motor distal latency(72.5%),reduced motor conduction velocity(54%)-both in at least 2 nerves and conduction block (41.2%) in at least 1 nerve. Detailed electrophysiological data in childhood GBS was not available in the literature to comment on. The low incidence of many of the electrical parameters was probably because in 22 cases the study was done within the first week of disease. The commonest abnormality in these 22 cases were abnormal F wave response in 90.9% and reduced CMAP amplitude in 77%.These 2 parameters were mentioned as the early electrophysiological abnormalities by Ropper et al[58].In clinically suspicious cases these parameters may help in diagnosis.

Reduced CMAP amplitude of less than 20% of the lower limit of normal in at least 2 nerves did not predict the need for assisted ventilation.

Follow up data was not obtained in a significant number of patients. At 3 months only 65% and at 6 months only 47% patients turned up for review. This less than optimal review visits could be multi factorial-good recovery, patients being from far away places in the state, or further follow up might have been with the local physician who referred these children to our center. At 3 months 83.3% of the patients were ambulant without support. At 6 months also this figure was similar(81%). Because of the small number of patients at follow up it was difficult to draw any conclusion from this pattern of similar outcome at both 3 and 6 months. In Kleyweg's[17] series 83% of children were ambulant without support at 12 months. All the 23 children in Epstein's[19] series attained stage 2 at 6 months. The reported complete recovery was 73% in the Paraguan series[15]. Complete or near complete recovery (combined stage 0 &1) at 6 months was only 57.6% in our series. The apparent worse outcome at 6 months in our study was probably because more number of patients who did not achieve complete recovery preferred to come for follow up and on the other hand, patients who had good functional recovery might have had their follow up with the local doctor. But this recovery may considered significant because our study group had the highest percentage of cases in stage 4 and 5.

Reduced CMAP amplitude of less than 20% of the lower limit of the normal in at least 2 nerves did not predict the chance of independent walking at 3 or 6 months. The prognostic value of electro physiology in childhood GBS has been rarely evaluated[45].Bradshaw et al in a retrospective study of childhood GBS indicated that the presence of a low CMAP amplitude of less than 20% of the lower limit of the normal was not useful prognostically[46].though the sample size was small, we also got similar results. On the contrary Reisin et al[47] had demonstrated that children with GBS and low mean CMAP amplitude or in-excitable nerves had a more severe disease, and slow recovery.

SUMMARY & CONCLUSIONS

SUMMARY AND CONCLUSIONS

1.The symptom at onset was sensory in a substantial number of patients.

2.The commonest preceding infection was upper respiratory tract infection.

3.Majority of the patients were already in stage 4 or 5 at the time of admission; probably because our institute is a tertiary care center.

4.The incidence of facial and bulbar weakness was high since more than 80% of the children were having severe disease.

5.More than 40% of the children required assisted ventilation because of the reasons mentioned in 3 & 4.But the mean duration of ventilation was less.

6.There were no deaths in the study group.

7.The commonest electrophysiological abnormalities in the first week of the illness were abnormal F wave responses and reduced CMAP amplitude in at least 2 nerves, which may be helpful in early doubtful cases.

8.Follow up data was very poor and we need to emphasize more in this regard.

9.At 3 months more than 80% children were ambulant without support. This is impressive considering the fact that more 80% of cases were in stage 4 or 5.

10.Reduced CMAP amplitude of less than 20% of the lower limit of normal did not have any prognostic value in predicting the need for assisted ventilation or independent ambulation at 3 or 6 months.

11.IVIG treatment did not have any statistically significant effect on the mean duration of ventilation or functional outcome at 3 and 6 months.

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