Published in final edited form as:

Vaccine. 2011 December 6; 29(52): 9697–9701. doi:10.1016/j.vaccine.2011.09.123.

Guillain–Barré Syndrome in India: Population-based validation of the Brighton criteria

Farrah J. Mateen^{a,b,d,*}, David R. Cornblath^a, Hamid Jafari^e, Russell T. Shinohara^c, Devendra Khandit^e, Bina Ahuja^e, Sunil Bahl^e, and Roland W. Sutter^d

Farrah J. Mateen: fmateen@jhspsh.edu

^aDepartment of Neurology, Johns Hopkins University, Baltimore, USA ^bDepartment of International Health, Johns Hopkins University, Baltimore, USA ^cDepartment of Biostatistics, Johns Hopkins University, Baltimore, USA ^dPolio Eradication Initiative, World Health Organization, Geneva, Switzerland ^eNational Polio Surveillance Unit of India, New Delhi, India

Abstract

Objective—Case definitions of GBS were recently developed in response to the 2009 H1N1 vaccination programme but have undergone limited field testing. We validate the sensitivity of the Brighton Working Group case definitions for Guillain–Barré Syndrome (GBS) using a population-based cohort in India.

Methods—The National Polio Surveillance Unit of India actively collects all cases of acute flaccid paralysis (AFP) in children <15 years old, including cases of GBS. Cases of GBS with available cerebrospinal fluid (CSF) and nerve conduction studies (NCS) results, neurological examination, clinical history, and exclusion of related diagnoses were selected (2002–2003). Relevant data were abstracted and entered into a central database. Sensitivity of the Brighton GBS criteria for level 3 of diagnostic certainty which requires no clinical laboratory testing, level 2 which employs CSF or NCS, and level 1 which employs both, were calculated.

Results—79 cases of GBS (mean age 6.5 years, range 4.0–14.5; 39% female) met the case definition. GBS cases were ascending (79%), symmetrical (85%), and bilateral (100%); involving lower extremity hypotonia (86%) and weakness (100%), upper extremity hypotonia (62%) and weakness (80%), areflexia/hyporeflexia (88%), respiratory muscles (22%), bulbar muscles (22%), and cranial nerves (13%). Four limbs were involved in 80% of cases. Mean time to maximal weakness was 5.2 days (range 0.5–30 days) with nadir GBS disability scores of 3 (7%), 4 (67%), 5 (15%), 6 (10%), or unclear (1%). CSF (mean time to lumbar puncture 29 days) was normal in 29% with cytoalbuminologic dissociation in 65% (mean protein 105 mg/dL, range 10–1000; mean cell count 11/μL, range 0–220, $n = 4$ with >50 cells/μL). Significant improvement occurred in 73% whereas death (9%) occurred 6–29 days after sensorimotor symptom onset. The majority of cases (86%) fulfilled Brighton level 3, level 2 (84%), and level 1 (62%) of diagnostic certainty.

Conclusion—The diagnosis of GBS can be made using Brighton Working Group criteria in India with moderate to high sensitivity. Brighton Working Group case definitions are a plausible standard for capturing a majority of cases of GBS in field operations in low income settings during AFP surveillance.

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*Corresponding author at: Department of Neurology, Pathology Building, Room 627, Johns Hopkins University, 600 North Wolfe Street, Baltimore, MD, USA. Tel.: +1 410 935 5181; fax: +1 410 502 2797.

Conflict of interest statement: All authors declare no conflicts of interest.

Drs. Jafari, Khandit, Ahuja, Bahl, and Sutter have no financial disclosures.

Keywords

Guillain–Barré Syndrome; Paralysis; Epidemiology; Surveillance; India

1. Introduction

Guillain–Barré Syndrome (GBS) is an acute, immune-mediated polyradiculoneuropathy and an important cause of acute flaccid paralysis (AFP) worldwide [1]. The number of cases of GBS increased following vaccination with the A76NJ 1976 influenza vaccine [2,3], leading to heightened awareness of GBS. There is a need for a valid, reliable, practical, and global consensus definition of GBS at various levels of certainty especially when new vaccines are developed and provided to large populations [4]. Several case definitions of GBS existed prior to the 2009 H1N1 vaccination campaign including the widely employed Asbury–Cornblath case definitions, which involve ancillary diagnostic tests [5,6]. More recently, the Brighton Collaboration developed case definitions of GBS with differing levels of diagnostic certainty [7]. These case definitions have undergone limited field testing, particularly in resource-poor settings.

GBS may be especially difficult to diagnose in resource-poor settings. Since the Brighton criteria include purely clinical case definitions as well as categories requiring further specialized testing, the need for additional resources to achieve diagnostic certainty for GBS could be challenging for large resource-poor populations.

In India, there is limited information available on the relative burden of GBS, particularly at a population level. Small case series of patients with GBS in India suggest that it may be an important cause of non-poliomyelitis AFP, including fatal AFP [8–10]. It is unknown whether the axonal subgroups, mainly acute motor axonal neuropathy (AMAN), are more common than the acute inflammatory demyelinating polyneuropathy (AIDP) form, as has been seen in other developing countries [11–13]. Based on nation-wide active surveillance data of AFP established by the global polio eradication initiative in India since 1997, we present a population-based cohort study of GBS in Indian children. We answer the following questions: (1) what are the epidemiological, clinical, laboratory, and electrophysiologic features of a subset of Indian children with GBS; and (2) what is the sensitivity of Brighton diagnostic criteria for GBS in children in India?

2. Methods

2.1. Epidemiological surveillance

The National Polio Surveillance Unit (NPSU) of India collects all cases of acute flaccid paralysis (AFP) in children <15 years (1997 to present) [14]. The system relies on weekly active surveillance in key health facilities (down to district hospitals) and passive reporting of AFP cases, immediate case investigations with collection of stool samples for virologic studies, and weekly active surveillance in key health facilities (down to district hospitals). AFP detection includes notification of children with any form of acute weakness including single extremity, multiple extremity, and/or facial nerve weakness by physicians, nurses, traditional medicine practitioners, and district medical officers. All reported cases are examined by a district NPSU surveillance medical officer (physician). The patient and/or family are interviewed as soon as possible after AFP detection occurs. Active surveillance occurs in all districts of all states in India and reports are sent to a central registry of the NPSU in New Delhi.

Stool samples are collected from each case of AFP to be tested for poliovirus. These samples are collected 24h apart and ideally within 14 days of AFP onset. Cases which (a) have tested negative for poliovirus types 1, 2 and 3; (b) have provided inadequate stool samples; or (c) were detected late (>14 days); as well as (d) had residual paralysis at 60 days following the onset of AFP are examined again by a district medical officer. Collateral history is taken from the treating physicians and caregivers again at 60 days in all cases. Cases are then reviewed by an expert committee at the NPSU comprised of three senior faculty-level paediatricians and/or neurologists in India according to the World Health Organization Virologic Classification Scheme [15].

As part of a programmatic initiative to determine the non-poliomyelitis causes of AFP, all children were requested to have nerve conduction studies, funded by NPSU, during the years 2002–2004. Cases with acute onset of AFP between 1 January 2002 and 31 December 2003 that were diagnosed by the expert panel as GBS in the study timeframe comprised the source population in this study.

2.2. Case ascertainment

The following demographic, epidemiological, and clinical variables were recorded: sex; date of birth; place of residence (by district and state in India); date and site of AFP onset; time to and degree of maximal weakness (graded by Medical Research Council Scale from 0 to 5); number of limbs affected at nadir; presence of fever, cranial nerve, bulbar, respiratory, and bowel or bladder involvement; clinical descriptive history; complete neurological examination; and date and cause of death (where applicable). Retrospectively, a GBS disability score was assigned ranging from 0 (normal) to 6 (death) [16].

Each patient's nerve conduction study report, including primary data and waveforms when available, was reviewed by two neurologists (FJM, DRC) and assigned a classification based on the criteria published by the Plasma Exchange/Sandoglobulin Guillain–Barré Syndrome Trial Group (1998) [17].

Further diagnostic evaluation including blood studies, cerebrospinal fluid examination, and radiographs for each case was at the discretion of the treating physicians. These studies, when available, were reviewed to confirm the etiologic diagnosis for AFP.

2.3. Case definitions

The Brighton Collaboration GBS Working Group 2010 guidelines [7] were applied to each case (see Appendix A). All cases in which GBS was considered to be the final diagnosis and met our inclusion criteria of having both CSF and NCS were analyzed for sensitivity.

2.4. Statistical analysis

The descriptive statistical analysis included examinations of means, standard deviations, frequencies, ranges, interquartile ranges, and percentages. Confidence intervals for means were obtained by inverting one-sample two-sided *t*-tests while confidence intervals for all proportions were based on score tests. Sensitivity was defined as the proportion of all cases of GBS meeting the given criteria of interest out of the total number of cases with CSF and NCS diagnosed with GBS by the India Expert Committee during the study timeframe. The statistical packages Stata (Version 11, 2009; Stata Corp., College Station, TX, USA) and R (Version 2.12.0, 2010; R Foundation for Statistical Computing, Vienna, Austria) were used.

3. Results

Between January 2002 and December 2003, a total of 18,213 AFP cases were reported. Of these, 2587 inadequate cases were reviewed by the Expert Committee in India and 832 (32.2%) were categorized as GBS (Brighton Level 4) (Fig. 1). 745 case files (745/832, 89.5%) were available and reviewed in detail for this study. Of these, 27 cases were discarded because of alternative diagnoses, including diphtheria, paralytic rabies, and transverse myelitis. Of the 718 remaining files, there were 79 (11%) cases where both cerebrospinal fluid analysis and NCS were performed (<5 years old $n = 38$, 48.1%; 5–9.9 years old $n = 21$, 26.6%, 10–14.9 years old ($n = 20$, 25.3%). Cases were derived from most states in India (Fig. 2) during all seasons (winter $n = 10$, 12.7%; spring $n = 19$, 24.1%, summer $n = 21$, 26.6%; and autumn $n = 29$, 36.7%). The baseline demographic characteristics and clinical features of this subgroup are provided in Table 1.

Cases were classified into five categories, based on the electrophysiological pattern of nerve conduction studies, as demyelinating ($n = 19$), axonal ($n = 14$), inexcitable ($n = 9$), normal ($n = 12$), or equivocal ($n = 22$) (Fig. 3). Three cases (3/79, 3.8%) were not classifiable into any category given an incomplete NCS and/or lack of primary data for analysis.

CSF was categorized as normal (protein between 15 and 45mg/dL, cell count ≤ 5 /mL, glucose $\geq 2/3$ of serum glucose or within normal laboratory range) or abnormal at the time of first lumbar puncture. CSF was normal in 44% at <7 days, 29% at 7 to <14 days, 24% at 14 to <21 days, 20% at 21 to <28 days, and 38% at 28 days or afterwards.

Sensitivities of each level of certainty are reported in Fig. 4. Brighton level was categorized as only a level 4 when the case lacked at least one feature found in the basic clinical definition of Brighton level 3 categorization ($n = 11$, 13.2%, 95% CI 7.3–22.6%). The clinical feature most often lacking was documented hypo- or areflexia (Fig. 1). A majority of cases met clinical criteria for GBS according to the Brighton Working Group (level 3, $n = 68$, 86.1%, 95% CI 76.5–92.8). All cases that were a Brighton level 1 also met the criteria for levels 2 and 3. All cases that met level 2 were also a level 3 (Appendix A). Sensitivity of level 2 was 83.5% (73.5–90.9%) and sensitivity of level 1 was 62.0% (95% CI 50.4%–72.7%). Cases of GBS associated with mortality were categorized as Brighton levels 1 ($n = 3$), 2 ($n = 3$), and 4 ($n = 1$).

Cases of GBS demonstrated significant improvement in 72%, minimal improvement in 9%, no improvement in 9%, and death in 9%.

4. Discussion

The diagnosis of GBS can be confirmed in low income countries using Brighton Working Group criteria with moderate to high sensitivity. The majority of clinically diagnosed GBS cases (86%) met the basic clinical definition of GBS (Brighton level 3) which requires neither CSF nor NCS analyses. There is little difference, and potentially no difference, between the sensitivity of Brighton levels 2 and 3 in this cohort (84% vs. 86%, $p > 0.05$).

Although a majority of cases met the level 3 diagnostic certainty level, 11 cases (14%) had a full diagnostic work up for GBS but failed to meet even level 3. These cases lacked documentation of hyporeflexia or areflexia, a core clinical feature of GBS according to the Brighton criteria. These cases may have otherwise exhibited CSF and NCS features compatible with the diagnosis. This highlights the need to document the core clinical features of reflexes, tone, and strength, and properly establish a symptomatic timeline in the field during active GBS surveillance. In the absence of complete documentation, Brighton level 4 will be diagnosed in spite of further resource-intensive studies.

The addition of one diagnostic study – either CSF analysis with a total white cell count of <50/mL, or in the case of no CSF studies, NCS with electrophysiological studies “consistent with GBS” –does not significantly change the sensitivity of the GBS diagnosis (84% vs. 86%). By adding either CSF or NCS with GBS-compatible results, only two fewer GBS cases were identified than with clinical diagnostic criteria alone.

Level 1 diagnostic certainty, the most stringent of categories, was met in 62% of all patients. In this cohort, cases which lacked albumino-cytologic dissociation on CSF analysis, with a normal CSF protein after one week of acute AFP presentation, or had an elevated CSF white count >50 cells/mL met level 2 but not a level 1. This occurred in 17 cases (22%). Notably, repeat or serial CSF studies in this cohort were rare.

The incidence of GBS in India has not been reported to the authors' knowledge, although annual incidence of all forms of AFP is recorded by the NPSU as part of the global effort to eradicate poliomyelitis. In 1968, a clinical case series from a tertiary care center in Chandigarh, India [18] reported the clinical features of 63 patients with GBS out of a total of 710 peripheral neuropathy patients observed from 1953 to 1965. Case fatality was 28.5%. More recent clinical case series have found a high incidence of cranial nerve palsies (76%) in children, respiratory paralysis (40%), and lower case fatalities (11–16%) [9,10,19]. In an unpublished study in India, it was estimated that 138 cases of GBS are seen annually in 7 major teaching hospitals, with approximately 75% of cases occurring in adults [8].

The relative predominance of electrophysiological subtypes of GBS is known to differ geographically. Where studied, Asian populations, including cohorts in Japan and China, demonstrate axonal predominance compared to the demyelinating subtype which is most common in Western populations [11,17,20]. In this cohort, the demyelinating subtype (25%) and axonal subtype (18%) were seen at approximately the same frequency but there was insufficient power to distinguish whether one is more common. Further studies in India would be of interest to delineate which electrophysiological patterns predominate at different ages, regions, and income levels.

This study has limitations. The application of Brighton diagnostic criteria was made retrospectively based on field reports by Indian medical officers and the patients could not be examined or evaluated by the authors. It would be preferable to validate the Brighton criteria in a prospectively designed study at the first point of care in the health care system. These cases were examined by paediatric neurologists and paediatricians near the time of AFP presentation. Cases where data were missing on a core clinical examination feature such as deep tendon reflexes were necessarily given a level 4 classification even though they may have had features consistent with a higher level of certainty. This analysis is limited to sensitivity alone (the probability that a person with GBS will be identified as such, i.e. true positive probability) and does not measure specificity (probability a person without GBS will be correctly identified as not having GBS). Therefore, patients in whom the diagnosis of GBS is uncertain may require both NCS and CSF analyses in order to rule out alternative etiologic diagnoses for clinical purposes. Brighton criteria are designed for monitoring, evaluation, and surveillance rather than guiding the care of an individual hospitalized patient.

There is likely a diagnostic evaluation bias in this subgroup: cases in which the weakness is severe and death is imminent are assumed more likely to have a complete diagnostic workup in India, including CSF. Therefore this subgroup likely represents a severe subset of GBS cases in India and is likely not representative of all GBS cases; however, this group may be the most important to diagnose given the severity of symptoms present. It is possible that milder cases of GBS are not reported given they resolve before reaching medical attention.

The effect of including those cases on Brighton level sensitivity calculations is uncertain, although a recent study from a high income setting in South Korea, assessing Brighton criteria for GBS in relation to the H1N1 monovalent vaccination programme, found sensitivity of levels 1, 2, and 3, to be 9%, 41%, and 50%, respectively [21].

Diagnosis of GBS will become increasingly important in India and other developing countries. Here, we have found the Brighton Working Group criteria to be sensitive and diagnostic in a low-income setting. As poliomyelitis eradication is achieved and widespread vaccination continues, the relative burden and need to monitor and report GBS will also rise. A field-tested, pragmatic, validated, and sensitive case definition of GBS will help achieve monitoring in times of both active and passive AFP surveillance.

Acknowledgments

The American Academy of Neurology (AAN) had no role in the design and conduct of the study; collection, management, analysis, or interpretation of the data; or preparation, review, or approval of the manuscript.

Funding: Dr. Mateen is supported by the 2010 Practice Research Fellowship Grant from the American Academy of Neurology. Dr. Cornblath has served as Consultant for Merck, Pfizer, Mitsubishi Pharma, Sanofi-Aventis, Baxter, Bristol-Myers Squibb, Eisai, Octapharma, Sun Pharma, Acorda, DP Clinical, Exelixis, Geron, Johnson & Johnson, Genzyme, Cebix, Abbott, CSL Behring, Ardea Biosciences and Bionevia; as DSMB member for Pfizer, Schwarz Biosciences, Avigen, Johnson & Johnson, Biogen and GlaxoSmithKline; and has Technology Licensing to and Royalties from Abbott, Johnson & Johnson, Sanofi-Aventis. Mr. Russell Shinohara is supported by the Epidemiology and Biostatistics of Aging Training Grant T32 AG000247.

Appendix A: Brighton Working Group clinical case definitions: Guillain–Barré Syndrome [7]

Level 1 of diagnostic certainty

The presence of

Acute onset of bilateral and relatively symmetric flaccid weakness/paralysis of the limbs with or without involvement of respiratory or cranial nerve-innervated muscles

AND

Decreased or absent deep tendon reflexes at least in affected limbs

AND

Monophasic illness pattern, with weakness nadir reached between 12h and 28 days, followed by clinical plateau and subsequent improvement, or death

AND

Electrophysiologic findings consistent with GBS

AND

Presence of cytoalbuminologic dissociation (elevation of cerebrospinal fluid (CSF) protein level above laboratory normal value, and CSF total white cell count <50 cells/mm³)

AND

Absence of an alternative diagnosis for weakness

Level 2 of diagnostic certainty

The *presence* of

Acute onset of bilateral and relatively symmetric flaccid weakness/paralysis of the limbs with or without involvement of respiratory or cranial nerve-innervated muscles

AND

Decreased or absent deep tendon reflexes at least in affected limbs

AND

Monophasic illness pattern, with weakness nadir reached between 12h and 28 days, followed by clinical plateau and subsequent improvement, or death

AND

Cerebrospinal fluid (CSF) with a total white cell count <50 cells/mm³(with or without CSF protein elevation above laboratory normal value)

OR

IF CSF not collected or results not available, electrodiagnostic studies consistent with GBS

AND

Absence of an alternative diagnosis for weakness

Level 3 of diagnostic certainty clinical case definition

The *presence* of

Acute onset of bilateral and relatively symmetric flaccid weakness/paralysis of the limbs with or without involvement of respiratory or cranial nerve-innervated muscles

AND

Decreased or absent deep tendon reflexes at least in affected limbs

AND

Monophasic illness pattern, with weakness nadir reached between 12h and 28 days, followed by clinical plateau and subsequent improvement, or death

AND

Absence of an alternative diagnosis for weakness

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Fig. 1.

Flow diagram for all children who had onset of acute flaccid paralysis (AFP) diagnosed as Guillain-Barré Syndrome (GBS) through active surveillance by the National Polio Surveillance Unit of India (2002–2003) and final Brighton classification of selected cases.

Fig. 2.
Map of India showing geographical distribution of GBS cases included in this study.

Fig. 3.
Histogram showing the electrophysiological pattern of GBS on nerve conduction studies, including 95% confidence intervals.

Fig. 4. Histogram showing the sensitivity of Brighton Diagnostic Levels of Certainty, including 95% confidence intervals.

Table 1

Clinical and demographic characteristics of 79 children with GBS in India.

Characteristic	Value
Female (% cases)	42
Mean age $\pm$ SD (range), y	6.6 $\pm$ 4.0 (4.0–14.5)
All limbs affected (%)	80
Mean time to maximal weakness (range) (days)	5.3 (0.5–30)
UE hypotonia (%)	62
LE hypotonia (%)	86
Hypo/areflexia (%)	88
Symmetrical weakness (%)	84
Ascending weakness (%)	78
Maximal degree of UE weakness (median, IQR)	3.4 (0–5)
Maximal degree of LE weakness (median, IQR)	2.1 (0–4)
Cranial nerve signs/symptoms (%) ^a	11
Bulbar signs/symptoms (%)	22
Respiratory involvement (%)	20
Babinski sign present (%)	3
Meningismus (%)	5
Fever present (%)	35
No. vaccinated with 3 doses of OPV (%)	94
CSF protein (mg/dL) (mean, range)	105 (10–1000)
CSF white cells (/mL) (mean, range)	10 (0–220)
CSF glucose (mg/dL) (mean, range)	61 (16–97)
Mean GBS disability score (range)	4.2 (3–6)
Case fatality (%)	8.9
Mean time from symptom onset to death (range) (days)	15 (6–29)

UE, upper extremity; LE, lower extremity.

^a CN II–VIII, XI–XII only.