RESULTS

Neural electro-physiological results

There were 102 cases (34.7%) in AIDP group and 81 cases (27.6%) in AMAN group [Figure 1]. Based on the first electro-physiological testing, 132 patients were classified into: 58 cases (43.9%) of AIDP, 24 cases (18.2%) of AMAN, 50 cases (37.9%) of unclear [Figure 2]. Cases belonged to AMAN group based on two different testing results were fewer than the cases in AIDP group and unclear classification cases group.

Relationship between early nerve conduction block and its electro-physiological changes

The first electro-physiological results for 132 cases with rechecks were: 58 cases (44%) in AIDP group, 24 cases (18%) in AMAN group, 50 cases (38%) in unclear classification group [Figure 3]. A total of 36 cases in AIDP group had CB, and cases transforming into AIDP and AMAN were 19 and 17, respectively.

Relationship between different types and the prognosis

The first electro-physiological results and the recheck results all demonstrated that comparing to AIDP, AMAN had more cases with poor prognosis [Tables 2 and 3] (all $P < 0.05$).

Relationship between early nerve conduction block and the severity of the illness

Results demonstrated that the severity of the illness was related to the development of CB in early stage in AIDP group and unclear classification group (all $P < 0.05$) [Table 4].

The results of Chi-squared test within each type of group were: in AIDP the value was 11.334, $P = 0.001$, in unclear classification the value is 8.408, $P = 0.004$, both with statistical significance; in AMAN group the value is 3.472, $P = 0.062$, with no statistical difference.

Relationship between early nerve conduction block and prognosis

Results demonstrated that irrespective of the severity of the disease, poor prognosis was not related to the development of CB (all $P > 0.05$) [Tables 5 and 6].

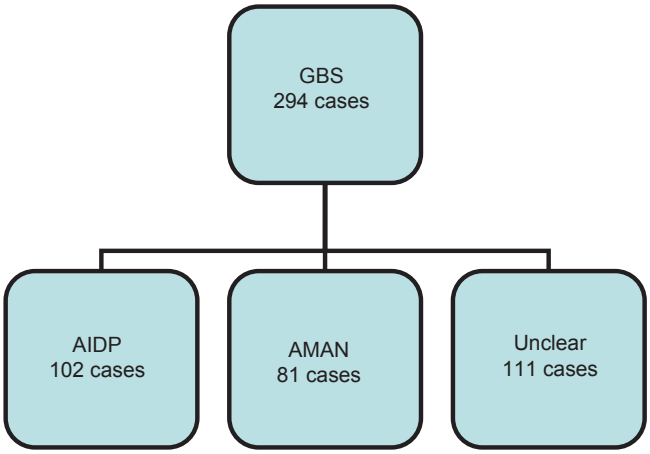

Figure 1: Neural electro-physiological results. GBS: Gillan-Barre syndrome; AIDP: acute inflammatory demyelinating poly-neuropathy; AMAN: acute motor axonal neuropathy

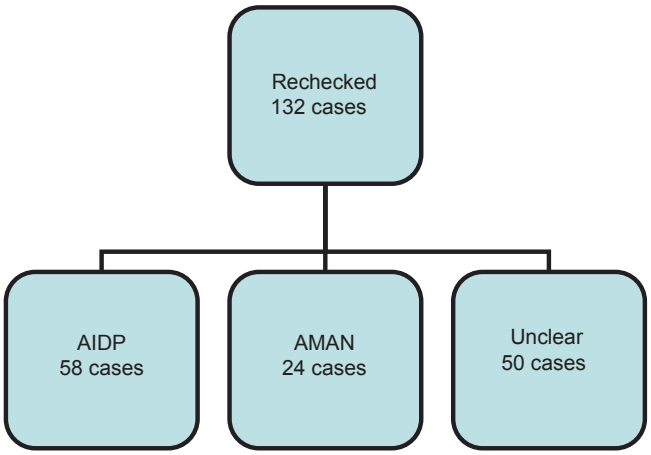

Figure 2: One hundred and thirty-two rechecked cases' first classification. AIDP: acute inflammatory demyelinating poly-neuropathy; AMAN: acute motor axonal neuropathy

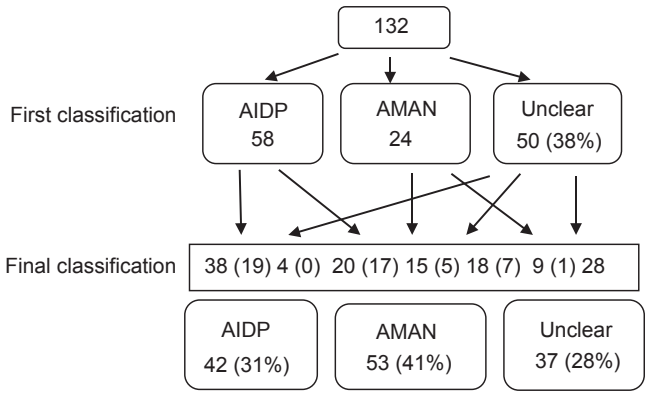

Figure 3: One hundred and thirty-two Gillan-Barre syndrome patients' first and final neural electro-physiological classifications (conduction block numbers in brackets clear to arrows). AIDP: acute inflammatory demyelinating poly-neuropathy; AMAN: acute motor axonal neuropathy

DISCUSSION

In this study, more male than female patients were included. Respiratory tract and intestinal infections were the most common precursor events. A few patients had influenza vaccine, H1N1 influenza vaccine and rabies vaccine before the onset of the illness. It has been reported that H1N1 vaccine maybe is a risk factor of GBS, but season influenza vaccine was not related to it.[5,6] In our data, there is no evidence that H1N1 influenza vaccine was related to GBS. The most common symptoms were symmetrical limb weakness and numbness. Sensory disturbance is usually milder than motor disturbance with reducing or disappearing tendon reflex. The common cranial nerve damages are facial nerve paralysis, drinking water choking, hoarseness, and ophthalmoplegial. All the cases were followed by telephone for 6 months after hospital

discharge. The response rate was 65.0%. Twenty-one percent of the patients had serous sequel which was the same as those reported in the literature. The mortality was 10.6% which was higher than previously reported.[6]

The most common subtypes of GBS are AIDP and AMAN with only motor fiber damage. According to the literature, in North America and Europe more than 90% of the patients is classified as AIDP,[4] but in China, the most common subtype is AMAN, and 65% of the GBS are AMAN.[7] In this study, most cases among the 294 GBS patients were AIDP. Of these, 132 cases were classified as AIDP based on their first electro-physiological examination. These findings are in contrast with what previously reported.

Because the classification based on early stage GBS electro-physiological results is inaccurate, electrophysiology testing was repeated after the illness developed and the percentage of AIDP and AMAN cases changed comparing to the early stage results.[8] We classified patients into AIDP and AMAN groups and unclear classification group which included patients whose electro-physiological testing were normal and those who did not meet the diagnostic criteria of AIDP and AMAN. We found that during disease progression electro-physiological results, as well as the electro-physiological classification, changed. The percentage of AMAN patients after recheck increased significantly compared to the first check (from 18% to 41%), which is the same as reported literature,[8,9] and AIDP reduced from 44% to 31%. We also found that AMAN had a worse prognosis than AIDP, and this finding is consistent with the literature,[10,11] thus suggesting a poor prognosis in more patients. The classification based on early stage GBS electrophysiologic results only may lead to inaccurate judgment of the patients' diagnosis and prognosis, instead continuous electrophysiology recheck can reflect the change of patient's condition without delay.

Among the patients transforming from AIDP into AMAN, CB occurred in 17 cases in the early onset of the illness: 5 and 7 cases in AMAN and unclear classification group, respectively. CB is a blockage in a nerve that prevents impulses from being conducted across a given segment although the nerve beyond is viable and is one of the important electro-physiological parameters of peripheral nerve functional status. CB is one of the physiological results caused by demyelination and is also the basic physiological mechanism of most clinical manifestations.[12] Most studies of CB published before are on multifocal motor neuropathy and amyotrophic lateral sclerosis, peroneal muscular atrophy and peripheral neuropathy caused by pressure.[13] Though conventional wisdom holds that the main cause of CB is demyelination and CB is the typical characteristics of demyelinating, recent studies demonstrated that demyelination is not the only reason for CB. It can caused by demyelination, depolarization on node of ranvier nearby axolemma, hyperpolarization and sodium channel damage.[14] The damage of nearby axolemma may cause CB, electro-physiological manifest as decreased amplitude, discretized waveform. If the illness continues to progress, reversible CB will turn into irreversible CB, and axonal degeneration. This might explain why some of the CB cases transformed into AMAN in electro-physiological classification.

Our study demonstrated that CB not only occurred in AIDP patients, but also in AMAN and unclear classification patients. In recent years, other groups found that CB plays an important role in axon damaged AMAN.[15,16] Kuwabara *et al*.[17] thought that the possible cause of CB in AMAN was axonal degeneration. The bridge type union of GM-1 antibody-mediated inflammatory cells and axons, the release of inflammatory mediators, local acidosis, damage on sodium ion channel of Axonal membrane and tight junction of axon myelin (some authors believe that this is a different type of demyelination from AIDP) resulted in a further decline of the safety factors, eventually leading to CB.[18]

Table 2: All cases classifications and prognosis

Prognosis	AIDP	AMAN	Total
Good prognosis	59	27	86
Poor prognosis	12	19	31
Total	71	46	117

$\chi^2 = 8.535$, $P = 0.003$. AIDP: acute inflammatory demyelinating poly-neuropathy; AMAN: acute motor axonal neuropathy

Table 3: Rechecked cases classifications and prognosis

Prognosis	AIDP	AMAN	Total
Good prognosis	35	8	43
Poor prognosis	6	9	15
Total	41	17	58

$\chi^2 = 9.197$, $P = 0.002$. AIDP: acute inflammatory demyelinating poly-neuropathy; AMAN: acute motor axonal neuropathy

Table 4: Relationship between different classifications nerve CB and the severity in 294 cases

Severity	AIDP			AMAN			Unclear		
	With CB	Without CB	Total	With CB	Without CB	Total	With CB	Without CB	Total
Slight	6	18	24	2	17	19	2	24	26
Severe	50	28	78	20	42	62	32	53	85
Total	56	46	102	22	59	81	34	77	111

AIDP: acute inflammatory demyelinating poly-neuropathy; AMAN: acute motor axonal neuropathy; CB: conduction block

Table 5: Early CB and prognosis of 140 severe GBS cases			
Prognosis	**With CB**	**Without CB**	**Total**
Good prognosis	46	54	100
Poor prognosis	15	25	40
Total	61	79	140

$\chi^2 = 0.840$, $P = 0.360$. CB: conduction block; GBS: Gillan-Barre syndrome

Table 6: CB and prognosis of 47 slight GBS cases			
Prognosis	**With CB**	**Without CB**	**Total**
Good prognosis	7	39	46
Poor prognosis	0	1	1
Total	7	40	47

$\chi^2 = 0.179$, $P = 0.672$. CB: conduction block, GBS: Gillan-Barre syndrome

Our results suggested that the severity of the illness was related to the development of CB in early stage in AIDP group and unclear classification group but in the AMAN group is limited by small sample size. As mentioned previously, damage factors of the axonal membrane may the cause of CB, and then reversible CB will turn into irreversible CB and axonal degeneration. According to the report of Kokubun *et al*.[9], the proportion of the two outcomes is 1:1 on AMAN patients who had CB. Patients in this group with CB in early stage were not related to the severity of the illness may be because some patients had reversible CB. In addition, the use of immunoglobulin in early stage of disease in patients with serious conditions may improve the prognosis and the finding that development into CB in early stage correlates with the severity of the illness might be another factor.

Due to the objective condition limit that our patients mostly come from surrounding cities and counties, and even other provinces, it is difficult to diagnose these patients' neurological recovery face-to-face after they are discharged from our hospital. We have to perform telephone follow-up for most of them. At the same time, many patients filled temporary numbers in the contact information form when hospitalized, which were no longer used after they went back. This also limited the follow-up results, and the response rate was only 65%. Furthermore, through telephone follow-up, we can't evaluate the neural function of patients completely and clearly. We will try to improve this in future work and research.

In conclusion, reversible CB might be the cause of changes in patients' electro-physiological classification. CB is not only a typical electro-physiological manifestation in AIDP, but also a manifestation of axonal degeneration for AMAN in the early stage. CB and axonal degeneration are caused by immune-mediated damage factors which attack axon membrane on the motor fiber. To a certain extent, CB is very helpful in classifying the severity of the illness.[14] Electrophysiology recheck can be very meaningful to reveal change of patient's condition, classification alteration and severity of the nerve damage in time.

REFERENCES

1. Dang JX. Electromyography Diagnosis and Clinical Applications. Beijing: People's Medical Publishing House; 2005.
2. Cui LY. Electromyography Condensed Handbook. Beijing: science Press; 2008.
3. Zhang KL, Xu JG. Clinical Utility of Electromyography Diagnosis Technology. Shanghai: fudan University Press; 2005.
4. Hadden RD, Cornblath DR, Hughes RA, Zielasek J, Hartung HP, Toyka KV, Swan AV. Electrophysiological classification of Guillain-Barré syndrome: clinical associations and outcome. Plasma Exchange/Sandoglobulin Guillain-Barré Syndrome Trial Group. *Ann Neurol* 1998;44:780-8.
5. Lehmann HC, Hartung HP, Kieseier BC, Hughes RA. Guillain-Barré syndrome after exposure to influenza virus. *Lancet Infect Dis* 2010;10:643-51.
6. Yuki N, Hartung HP. Guillain-Barré syndrome. *N Engl J Med* 2012;366:2294-304.
7. Ho TW, Mishu B, Li CY, Gao CY, Cornblath DR, Griffin JW, Asbury AK, Blaser MJ, McKhann GM. Guillain-Barré syndrome in northern China. Relationship to Campylobacter jejuni infection and anti-glycolipid antibodies. *Brain* 1995;118:597-605.
8. Uncini A, Manzoli C, Notturno F, Capasso M. Pitfalls in electrodiagnosis of Guillain-Barré syndrome subtypes. *J Neurol Neurosurg Psychiatry* 2010;81:1157-63.
9. Kokubun N, Nishibayashi M, Uncini A, Odaka M, Hirata K, Yuki N. Conduction block in acute motor axonal neuropathy. *Brain* 2010;133:2897-908.
10. Hiraga A, Mori M, Ogawara K, Hattori T, Kuwabara S. Differences in patterns of progression in demyelinating and axonal Guillain-Barré syndromes. *Neurology* 2003;61:471-4.
11. Brown WF, Feasby TE, Hahn AF. Electrophysiological changes in the acute "axonal" form of Guillain-Barre syndrome. *Muscle Nerve* 1993;16:200-5.
12. Liu T, Lu ZN. Demyelinating neuropathy physiological basis of conduction block. *Str Nerv Dis* 2006;13:59.
13. Ghosh A, Donaghy M. Multifocal motor neuropathy. *Neurol India* 2002;50:408-16.
14. Tang XF. Current insights into nerve block. *Chin J Neuo* 2003;36:404.
15. Kokubun N, Shahrizaila N, Hirata K, Yuki N. Conduction block and axonal degeneration co-occurring in a patient with axonal Guillain-Barré syndrome. *J Neurol Sci* 2012;319:164-7.
16. Raguer N, Gratacós M, Lladó E, Lara N, Seoane JL, Benito M, Rio J, Gámez J. Acute motor axonal neuropathy (AMAN), description of neurophysiological findings in 8 patients with early nerve conduction blocks. *Clin Neurophysiol* 2006;117:1-2.
17. Kuwabara S, Bostock H, Ogawara K, Sung JY, Kanai K, Mori M, Hattori T, Burke D. The refractory period of transmission is impaired in axonal Guillain-Barré syndrome. *Muscle Nerve* 2003;28:683-9.
18. Wang RB, Liu XZ. Nerve conduction block and its mechanism. *J Brain Nerv Dis* 2006;14:239.

Cite this article as: Wang YC, Feng GD, Wang J, Liu XD, Zhao G. Effect of conduction block in classification and prognosis of Guillain-Barre syndrome. Neuroimmunol Neuroinflammation 2014;1(2):77-81.

Source of Support: Nil. **Conflict of Interest:** No.

Received: *12-05-2014*; **Accepted:** *18-07-2014*