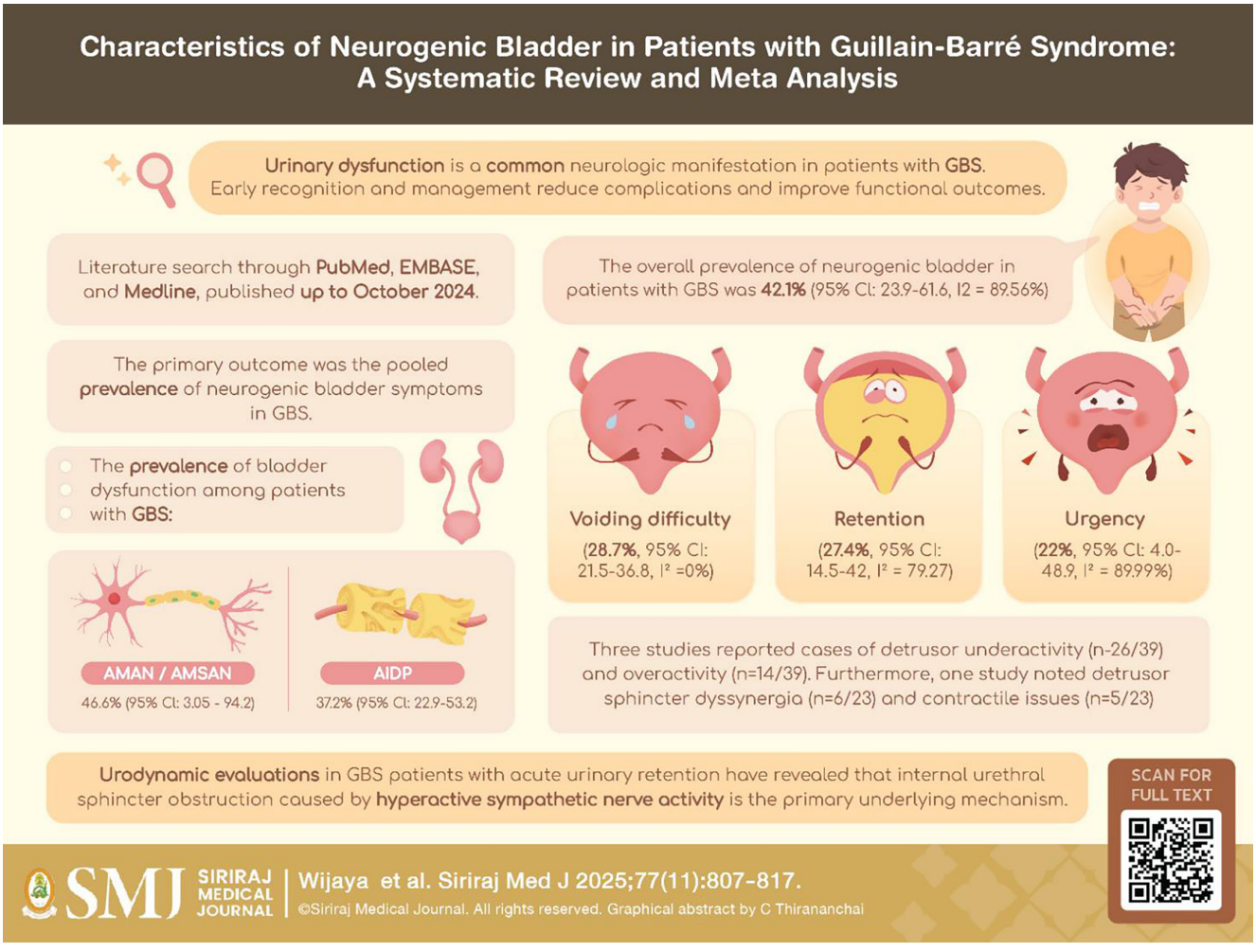
Characteristics of Neurogenic Bladder in Patients with Guillain-Barré Syndrome: A Systematic Review and Meta-analysis

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ABSTRACT

Objective: This review aims to determine the prevalence and characteristics of neurogenic bladder issues in patients diagnosed with Guillain-Barré Syndrome.

Materials and Methods: The authors conducted a literature search through PubMed, EMBASE, and Medline, published up to October 2024. Moreover, supplementary sources were obtained through the examination related references. Studies presenting the urinary dysfunction features of GBS patients in their data were included. The primary outcome was the pooled prevalence of neurogenic bladder symptoms in GBS. The quality of the included studies was evaluated using the Oxford Centre for Evidence-Based Medicine guidelines. Selected studies were included in the meta-analysis of proportion and heterogeneity test.

Results: From 257 identified studies, 6 observational studies were included in the final analysis, with 375 participants included. The overall prevalence of neurogenic bladder in patients with GBS was 42.1% (95% CI: 23.9-61.6, I^2 = 89.56%). Voiding difficulty (28.7%, 95% CI: 21.5-36.8, I^2 =0%), retention (27.4%, 95% CI: 14.5–42, I^2 = 79.27), and urgency (22%, 95% CI: 4.0–48.9, I^2 = 89.99%) was commonly reported bladder symptoms, respectively. Acute Axonal Pattern (AMAN/AMSAN) was more common (46.6%, 95% CI: 3.05-94.2, I^2 =95.31%) than Acute Demyelinating Pattern (AIDP) (37.2%, 95% CI: 22.9-53.2, I^2 = 0%). Detrusor underactivity (n=26/39) was mostly reported findings based on urodynamic tests.

Conclusion: Urinary dysfunction is a common neurologic manifestation in patients with GBS. Early recognition and management reduce complications and improve functional outcomes.

Keywords: Neurogenic bladder; GBS; urinary dysfunction (Siriraj Med J 2025; 77: 807-817)

INTRODUCTION

Guillain-Barré syndrome (GBS) is defined as an acute immune-mediated neurological disorder characterized by the demyelination of nerve cells, which manifests as polyradiculoneuropathy. A common presentation includes a gradual ascending weakness in the extremities, as well as bulbar or ocular muscle involvement.[1] Although less typical, autonomic dysfunction, particularly lower urinary tract issues, may present as the initial symptom of GBS.[2,3] Therefore, the prompt recognition of this condition is crucial to prevent further complications.

A previous study involving 65 GBS patients found that 27.7% experienced bladder dysfunction, with urine retention reported in 9.2% of cases. In a longitudinal cohort study, over one-third of patients with GBS reported experiencing urinary urgency and frequency, with nearly 50% noting that these issues disrupted their daily activities. Additional urodynamic abnormalities included underactive and overactive detrusor, as well as, to a lesser extent, hyperactive sphincter has been linked as underlying mechanism. Urinary complications were more common in the GBS subtype of acute inflammatory demyelinating polyneuropathy (AIDP) compared to acute motor axonal neuropathy (AMAN), and these issues were associated with severity of disease and coexisting of bowel impairment.[4,5]

Recent studies indicate that bladder dysfunction affects more than a quarter of individuals with GBS; however, it often goes underdiagnosed, suggesting that the actual prevalence may be higher than reported. Consequently, the complete spectrum of this syndrome remains unclear. Furthermore, only a limited number of investigations have documented neurogenic bladder symptoms in GBS. This review aims to determine the prevalence and characteristics of neurologic bladder issues in patients diagnosed with Guillain-Barré Syndrome. Consequently, this meta-analysis is necessary to clarify the discrepancies of urinary disturbances prevalence in GBS.

MATERIALS AND METHODS

Search strategy and selection criteria

A systematic review followed by a meta-analysis was conducted according to Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines.[6] A comprehensive literature search was conducted using PubMed, EMBASE, and Medline databases, focusing on publications up to 31 October 2024. The literature search utilized the terms "neurogenic bladder" OR "bladder" OR "urinary" AND "Guillain-Barré Syndrome," as well as their relevant derivatives from selected articles. Additionally, we reviewed the reference lists of these papers and their subsequent citations to identify further relevant studies. We included observational studies that reported prevalence data concerning bladder dysfunction among patients with Guillain-Barré Syndrome. Moreover,

we reviewed the reference lists of the articles through our search strategy to uncover any additional studies that may have been overlooked.

Studies were included if they reported bladder symptoms in patients over 18 years, with a diagnosis of GBS based on clinical electrophysiology findings. The definition of "neurogenic bladder" in our study was considered as symptoms of urinary retention, urgency, incontinence, and voiding difficulty caused by damage in nervous system without any other potential causes (e.g., obstructive, urinary tract infection). The exclusion criteria were 1) non-original studies (e.g. review articles); 2) were written in non-English languages; 3) non-human subjects; 4) conference papers, conference presentations, books, graduate degree theses, and another non-peer-reviewed articles. In line with our primary objective, participants which had pre-existing urinary tract symptoms before the onset of GBS were also excluded. Patients with comorbidity of urinary infection as a complication of hospital stay were also excluded in our search strategy.

The eligibility of studies was initially assessed through independent screening of titles and abstracts by two authors. Full-text articles that passed the initial screening were subsequently reviewed by two reviewers to confirm their compliance with the established inclusion and exclusion criteria. Data were extracted for each eligible study into a customized spreadsheet by one reviewer. Additionally, articles referenced in the collected studies were included and manually screened. Any discrepancies were resolved in consultation with the third author. From each reviewed article, the following data were extracted and organized: author names, study design, country of origin, study population, participant age, bladder symptoms, and main findings.

Assessment of quality and risk of bias

The quality of each study was assessed using the Oxford Centre for Evidence-Based Medicine quality ratings, which range from Level 1 to 5. Level 1 indicating a well-powered and appropriately conducted randomized controlled trial (RCT), and Level 5 reflecting expert opinion and case reports.[7]

Statistical analysis

The primary outcome of the study was the pooled prevalence of neurogenic bladder manifestations in GBS, utilizing point prevalence estimates when available. The I^2 tests were employed to assess heterogeneity among the studies, with studies exhibiting an I^2 value greater than 50% classified as having high heterogeneity. A fixed-effects model was applied in situations where no significant heterogeneity was detected among the studies; conversely, a random-effects model was utilized when the data were determined to be heterogeneous. Forest plots were used to illustrate the proportions reported in each study, along with the combined estimated prevalence plots accompanied by 95% confidence intervals. Substantial heterogeneity was defined as $I^2 > 50\%$ and statistical significance was established at $p < 0.05$. The analysis was performed using MedCalc V.19.2.0 software.

RESULTS

An initial search yielded 257 potentially relevant manuscripts based on the applied search strategy. Following the application of exclusion criteria, 66 articles were screened for eligibility, of which six studies fulfilled the inclusion criteria and were included in the quantitative synthesis. The search and selection process are illustrated in the PRISMA flow diagram (Fig 1).

Study characteristics

This review incorporated two prospective studies[5,11], two retrospective studies[10,12], and two cross-sectional studies[4,9] encompassing a total of 275 patients (with sample sizes ranging from 7 to 171) who had a previous history of GBS. Patient data for the included studies originated from multiple countries, including the United States, Japan, India, and Australia. The characteristics and quality ratings of the studies included in this meta-analysis are detailed in Table 1.

The overall prevalence of neurogenic bladder among patients with GBS was found to be 42.1% (95% CI: 23.9-61.6) across four studies[4,5,11,12], which comprised a total of 240 subjects and exhibited a high level of heterogeneity ($I^2 = 89.56\%$), as shown in Table 2. Additionally, the forest plot depicting the prevalence (%) of neurogenic bladder in GBS is presented in Fig 2.

According to electrodiagnostic findings, the prevalence of bladder dysfunction among patients with Guillain-Barré Syndrome (GBS) is documented at 46.6% (95% CI: 3.05-94.2) for the Acute Axonal Pattern (AMAN/AMSAN) and 37.2% (95% CI: 22.9-53.2) for the Acute Demyelinating Pattern (AIDP), as detailed in Table 3. Forest plots illustrating the prevalence (%) of patients with both the Acute Axonal Pattern and the Acute Demyelinating Pattern are presented in Fig 3.

Voiding difficulty is the most commonly reported bladder symptom among patients with GBS, with an overall pooled prevalence of 28.7% (95% CI: 21.5-36.8) derived from a total of 141 subjects, displaying a low level of heterogeneity ($I^2 = 0\%$). A forest plot depicting the prevalence (%) of voiding difficulty is provided in

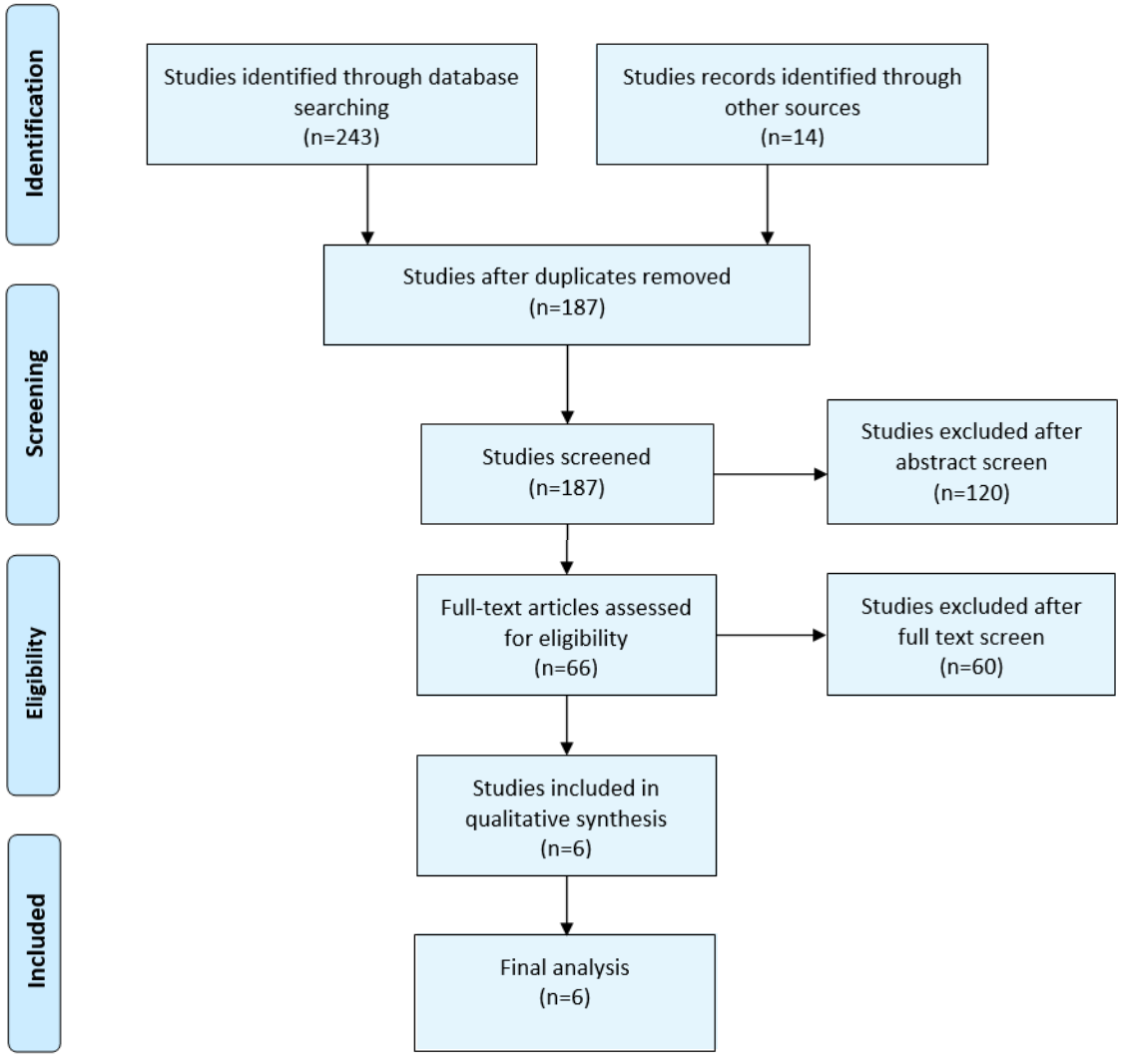


Fig 1. Study selection process.

Fig 4. The random-effects analysis also revealed the proportions of other symptoms, such as retention, which was found in 27.4% of patients (95% CI: 14.5–42.7; Fig 5; 219 subjects), and urgency, reported at 22% (95% CI: 4.0–48.9; Fig 6; 141 subjects), as summarized in Table 4.

Additionally, we included studies that examined bladder dysfunction in GBS patients through urodynamic tests, as outlined in Table 5. Three studies reported cases of detrusor underactivity (n=26/39) and overactivity (n=14/39). Furthermore, one study noted detrusor sphincter dyssynergia (n=6/23) and contractile issues (n=5/23).

DISCUSSION

The analysis included a total of 275 patients, of whom 42.1% exhibited signs of bladder dysfunction. Previous studies have reported a prevalence of dysautonomia as high as 67%, with bladder dysfunction observed in 11% to 30% of cases.[9] Additionally, a past cohort study indicated that more than half of subjects with GBS experienced urinary dysfunction, which can significantly impact daily living.[9,10]

The variability in reported prevalence among studies may be attributed to the diagnostic challenges faced, particularly in acute settings. The diagnostic criteria for GBS specify that bladder dysfunction is a diagnosis of exclusion, likely because it is essential to distinguish GBS patients from those with acute myelopathy, where urinary retention is frequently present.[9] However, the identification of upper motor neuron signs might aid in differentiating these conditions.[4,11,12] Bladder dysfunction occurring at symptom onset, coupled with a deficit in sensory level, can complicate the diagnosis of GBS and suggest acute myelopathy. Additionally, the presence of lost reflexes or areflexia may help differentiate these conditions during physical examinations. While unusual, sensory level changes and bladder dysfunction may manifest as initial symptoms of GBS.[12]

TABLE 1. Studies included in systematic review.

No	Author	Study Type	Country	Study Group	Median (range) or Mean (SD) Age	Follow-Up Duration	Neurogenic Bladder Diagnosis	Bladder Symptoms and/ or % of Total	Key Findings/ Summary	Study Quality Level
1	Sakakibara et al, 2009[4]	Cross Sectional	Japan	65 GBS patients	41 (13-81)	Not applicable	Urodynamic Study	Urinary symptoms observed in 27.7% patient: • Urinary retention (9.2%) • Voiding difficulty (24.6%) • Urinary urgency (7.7%)	Urinary symptoms more common in woman (37.5%), older than 35 years (31.4%) and, AIDP type of GBS (39%).	4
2	Amatya et al, 2013[5]	Prospective Cohort	Australia patients	66 GBS	55.6 (18.1)	3-6 weeks	Questionnaire	• Incomplete emptying (19.7%) • Frequency (33.3%) • Intermittency (27.3%) • Urgency (39.4%) • Weak stream (33.3%) • Straining (12.1%) • Nocturia (59.1%)	• Urinary symptoms interfered with daily life in 49% of cases, while 10.6% reported a negative impact on quality of life (QoL). • A significant relationship was observed between bladder symptoms and both the level of urogenital distress ($p < 0.001$) and the impact of urinary problems ($p < 0.001$). Higher scores on bladder symptom scales were also significantly correlated with psychological distress, functional limitations, and reduced participation.	2

TABLE 1. Studies included in systematic review. (Continue)

No	Author	Study Type	Country	Study Group	Median (range) or Mean (SD) Age	Follow-Up Duration	Neurogenic Bladder Diagnosis	Bladder Symptoms and/ or % of Total	Key Findings/ Summary	Study Quality Level
3	Wheeler et al, 1984[9]	Cross Sectional	Massachusetts	7 GBS patients	51 (32-60)	Not applicable	Urodynamic Study	• Detrusor areflexia with appropriate sphincter relaxation (57.1%) • Detrusor hyperreflexia (42.9%)	• Urological changes began after the neurologic changes • Urodynamic evaluation was performed at average 9 weeks (range 3-24 weeks) of voiding dysfunction	4
4	Sakikibara et al, 1997[10]	Retrospective study	Japan	28 GBS patients	37 (8-69)	Not applicable	Urodynamic Study	• Micturition disturbance in 7 of 28 patient (25%) • The major symptoms of micturition disturbance were: - Voiding difficulty (6 of 7 patient) - Transient urinary retention (3 of 7 patient) - Nocturnal urinary frequency (3 of 7 patient) - Urinary urgency (3 of 7 patient) - Diurnal urinary frequency (2 of 7 patient) - Urge urinary incontinence (2 of 7 patient) - Stress incontinence (2 of 7 patient)	Micturition symptoms emerged following the onset of weakness and gradually improved in parallel with other neurological signs.	3

TABLE 1. Studies included in systematic review. (Continue)

No	Author	Study Type	Country	Study Group	Median (range) or Mean (SD) Age	Follow-Up Duration	Neurogenic Bladder Diagnosis	Bladder Symptoms and/ or % of Total	Key Findings/ Summary	Study Quality Level
5	Naphade et al, 2012[11]	Prospective Cohort	India	38 GBS patients	28 (9-65)	2 months	Urodynamic Study	Urodynamic abnormality (60.53%) - Detrusor underactivity (65%) - Detrusor sphincter dyssynergia (26%) - Detrusor overactivity (13%)	• Urodynamic abnormalities were more commonly found in axonal variant of GBS • Patients with urodynamic abnormality significantly had more disability based on Hughes motor grade. • Patients with normal urodynamic at baseline, continued to show normal results after 2 months of follow-up	2
6	Chakraborty et al, 2020[12]	Case control	United States	171 GBS patients	55 (16)	Not applicable	Clinical Findings	• Urinary Retention, 17 (23.9%)	• The study included 171 patients with GBS, of which 71 (38%) exhibited signs of dysautonomia. • 72% of patients had demyelinating type and 36% of this patients had dysautonomia.	3

TABLE 2. Overall proportion of neurogenic bladder in patients with GBS.

Studies	Sample size	Prevalence (%)	95% CI	Weight (%)		I^2	p value
				Fixed	Random		
Sakakibara 2009	65	27.7	17.3 to 40.2	27.1	25.3		
Naphade 2012	38	60.5	43.4 to 76	15.9	23.8		
Amatya 2013	66	59.1	40.3 to 71	27.5	25.3		
Chakraborty 2020	71	23.9	14.6 to 35.5	29.5	25.5		
Total (random effects)	240	42.1	23.9 to 61.6	100	100	89.56 %	< 0,0001

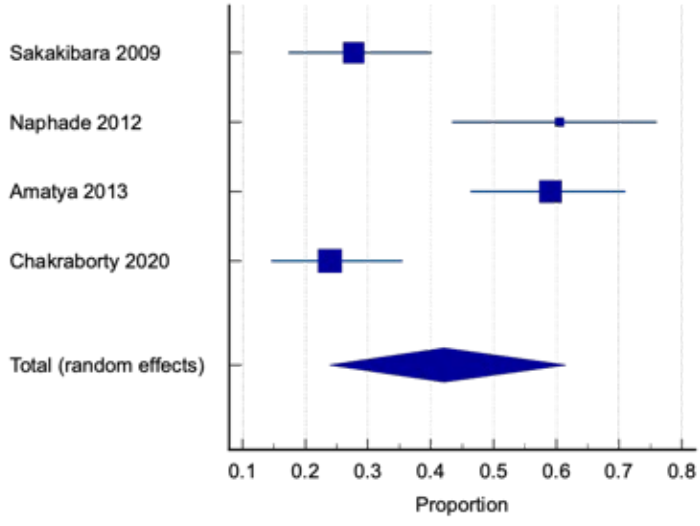


Fig 2. Forest plot demonstrating the pooled prevalence (%) of neurogenic bladder in patients with GBS across included studies, with corresponding 95% confidence intervals.

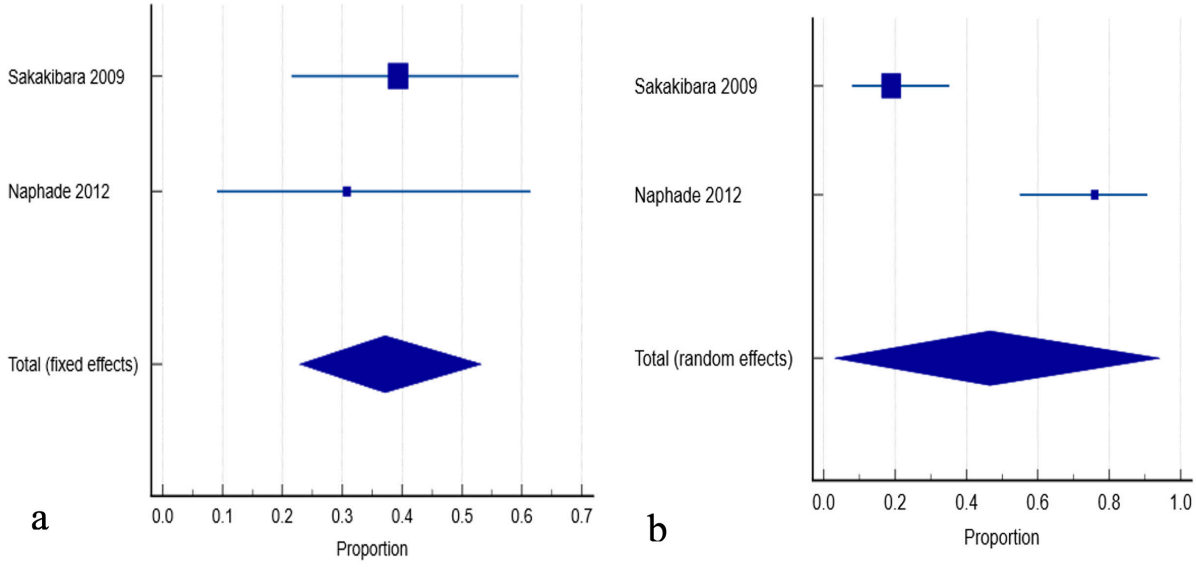


Fig 3. Forest plot demonstrating proportion of neurogenic bladder in patients with (a) Acute Demyelinating Pattern (AIDP) and (b) Acute Axonal Pattern (AMSAN) across included studies, with corresponding 95% confidence intervals.

TABLE 3. Results of meta-analysis of neurogenic bladder proportion based on GBS patterns.

Symptoms	Number of studies	Pooled sample size	Pooled prevalence (%)	95% CI	I^2	p value
Acute Demyelinating Pattern (AIDP)	2	41	37.2	22.9 to 53.2	0%	0,627
Acute Axonal Pattern (AMAN/AMSAN)	2	62	46.6	3.05 to 94.2	95,31%	< 0,0001

TABLE 4. Results of meta-analysis of proportion based on bladder symptoms in patients with GBS.

Symptoms	Number of studies	Pooled sample size	Pooled prevalence (%)	95% CI	I^2	p value
Retention	5	219	27.4	14.5 to 42.7	79,27%	0,0007
Voiding difficulty	3	141	28.7	21.5 to 36.8	0%	0,4905
Urgency	3	141	22.0	4.0 to 48.9	89,99%	< 0,0001

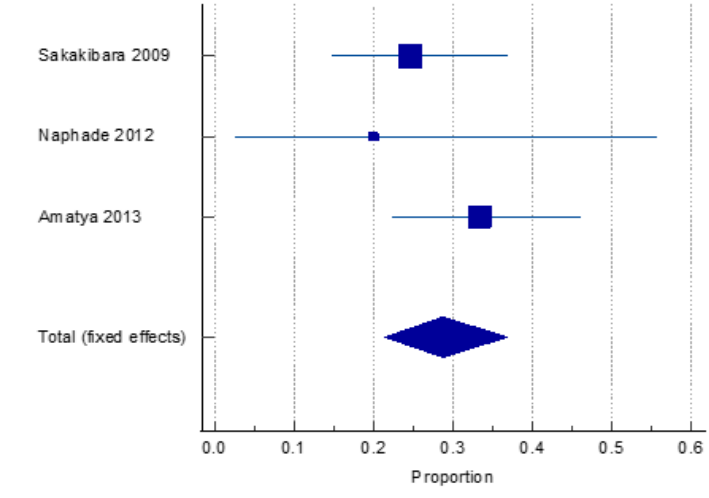


Fig 4. Forest plot demonstrating the proportion estimates (%) of voiding difficulty in patients with GBS across included studies, with corresponding 95% confidence intervals.

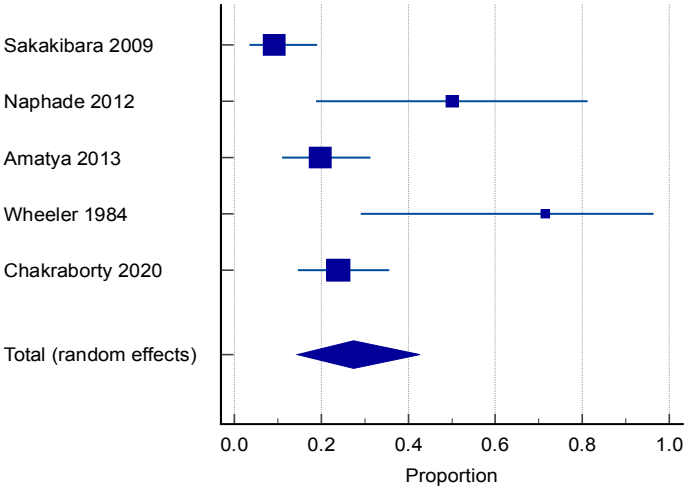


Fig 5. Forest plot demonstrating the proportion estimates (%) of urinary retention in patients with GBS across included studies, with corresponding 95% confidence intervals.

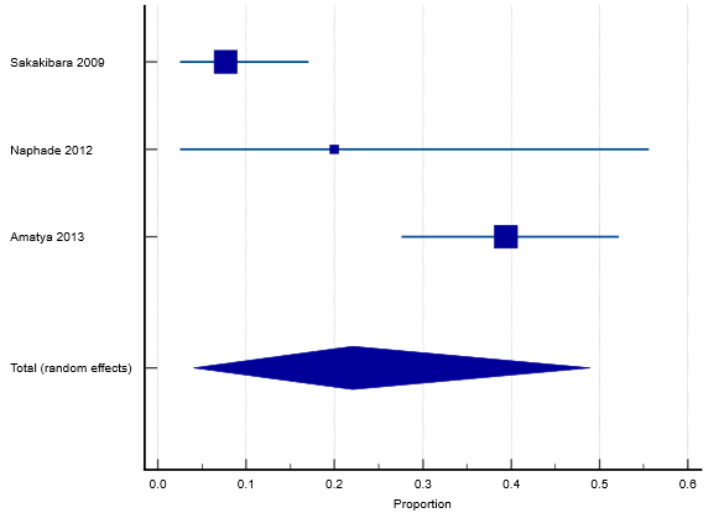


Fig 6. Forest plot demonstrating the proportion estimates (%) of urinary urgency in patients with GBS across included studies, with corresponding 95% confidence intervals.

TABLE 5. Proportion of bladder dysfunction in patients with GBS based on urodynamic findings.

Studies	Detrusor Underactivity (n)	Detrusor Sphincter Dyssynergia (n)	A contractile (n)	Overactivity (n)	Total sample (n)
Wheeler 1984	7	NR	NR	8	9
Sakakibara 2009	15	6	5	3	23
Naphade 2012	4	0	0	3	7

Studies have investigated the autonomic mechanisms involved in bowel and bladder function in GBS. Urodynamic evaluations in GBS patients with acute urinary retention have revealed that internal urethral sphincter obstruction caused by hyperactive sympathetic nerve activity is the primary underlying mechanism, rather than bladder paralysis due to parasympathetic failure. Other potential mechanisms include non-relaxation of the urethral sphincter during voiding (sphincter dysfunction), reduced bladder sensation from afferent fibers damage in the bladder wall or possible overdistension injuries in the early phase of urinary retention, along with detrusor overactivity.[12,13]

In our GBS patients, the most common urinary symptoms were voiding difficulties (24.6%) and urinary retention (9.2%). Previous case series of GBS have also reported a predominance of voiding symptoms. The lower urinary tract alternates between storage and voiding functions through specific autonomic innervation. Consequently, neuropathic involvement of the bladder may contribute to both voiding and storage symptoms.[14]

Functional evaluations such as uroflowmetry, post-void residual measurement, and urodynamic studies are essential to detect detrusor underactivity in patients who present with suspected neurogenic bladder, including patient with GBS.[15] However, data on urodynamic studies performed during the acute phase for participants is quite limited. In a recent study, these assessments were conducted within 8 weeks following the onset of the disease. Bladder underactivity, specifically areflexia, is more prevalent than overactivity. An underactive detrusor muscle is commonly observed in cases of peripheral neuropathy, suggesting a lesion in the parasympathetic postganglionic cholinergic nerves. The inflammation or immune dysfunction affecting the lumbosacral autonomic fibers may provide insight into the underlying causes.[9,11,16]

This review has some limitations. As this review excluded studies not published in English, there is a potential for language bias, and relevant evidence published in other languages may have been overlooked. Additionally, most of the studies included in this review were inherent to its retrospective design, thus the manifestation of urinary dysfunction was made based on medical records making it difficult to track the trajectory of the disease. Prevalence of urinary dysfunction may have been underreported because milder forms might have gone untreated, the use of urinary catheterization may have occurred before urinary retention became evident especially due to pre-existing comorbidities, and medications may have contributed to their occurrence. In a 6-year cohort study, reported that autonomic dysfunction was a predictor of mechanical ventilation use in severe GBS.[17]

In this review, subgroup analysis was not performed since neurogenic bladder was not the primary outcome of most of included studies, therefore only prevalence estimates of bladder dysfunction could be extracted. Most of the studies also had limited duration of follow up, therefore the prognosis of GBS patients with urinary dysfunction was not concluded. Until today, the optimal treatment of dysautonomia in which urinary dysfunction in GBS has not been well studied. The treatment goals include achieving social continence, alleviating symptoms, promoting consistent and complete bladder emptying at suitable intervals, preventing infections, and preserving renal function. Further well-designed prospective cohort studies with a longer follow-up period and standardized urodynamic testing are required to support the finding of this study. This review highlights the need for increased clinical awareness and may contribute to the development of practical approaches for screening and managing bladder dysfunction in patients with GBS.

CONCLUSIONS

Our study emphasizes that urinary dysfunction is a common manifestation of autonomic dysfunction in hospitalized patients admitted for GBS. Early recognition and management can prevent further deterioration of the disease and improve functional outcomes.

Data Availability Statement

The data supporting the findings of this review are available within the article.

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DECLARATIONS

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Conflict of Interest

The authors declare no competing interests.

Registration Number of Clinical Trial

PROSPERO CRD420251018021.

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Author Contributions

V.O., D.M., D.P., K.A.; conceptualization. V.O., D.M.; methodology and formal analysis: V.O., D.P.; Original draft of the manuscript. K.A.; visualization. V.O., D.M.; validation, review and editing of the manuscript. All authors read and approved the final manuscript.

Use of Artificial Intelligence

Not applicable.

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