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Challenging the Causative Link Between Guillain-Barré Syndrome and Bariatric Surgery: A Systematic Review

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Abstract

This study aims to shed light on the risk of Guillain-Barré syndrome (GBS), a rare but potentially devastating neurological condition following bariatric surgery. By investigating the potential factors contributing to the risk of GBS following bariatric surgery, we hope to provide valuable insights to our medical community. We conducted a comprehensive literature review using PubMed and Google Scholar databases, describing adult GBS in patients having undergone bariatric surgery, reported between January 2002 and January 2023. This thorough review was complemented by data from the bariatric surgery registry of a leading tertiary-care hospital for bariatric surgeries, ensuring a robust comparison with cases detected locally. Thirty-five adult patients were identified as having GBS after undergoing bariatric surgery, with two cases of GBS recorded among the 3,600 bariatric surgery patients in the hospital registry. A literature review revealed 33 GBS cases following bariatric surgery, primarily associated with patients undergoing sleeve gastrectomy. Neurological deficits, including motor weakness, sensory deficits, and autonomic dysfunction, were shared. Significant micronutrients and vitamins B1, B6, B12, and E deficiencies were noted. As for treatment, intravenous immunoglobulin was administered to 37% of the patients, along with various other interventions. A complete recovery was observed in 25% of the patients. The risk of GBS associated with bariatric surgery is an increasing concern. Nutritional deficiencies following surgery may contribute to changes in autoimmune and inflammatory mechanisms, potentially leading to the development of GBS. The outcomes of this study emphasize the importance of clinicians maintaining a heightened awareness of the risk of GBS in bariatric surgery patients, ensuring timely diagnosis, and creating strategies to optimize outcomes.

Keywords: *Obesity; Bariatric Surgery; Guillain-Barré Syndrome (GBS); Middle East; Vitamins; Micronutrients*

Abbreviations

AMAN: Acute Motor Axonal Neuropathy; AMSAN: Acute Motor and Sensory Axonal Neuropathy; AS: Autonomic symptoms; BMI: Body Mass Index; DTR: Deep tendon reflexes; F: Female; IVIg: Intravenous Immunoglobulins; LL: Lower Limbs; M: Male; MP: Motor Power; MT: Muscle Tone; MVT: Multivitamins; Vit: Vitamin; Ca: Calcium; NCS: Nerve Conduction Study; PT: Physiotherapy; SS: Sensory System; TPLEX: Therapeutic Plasma Exchange; UL: Upper Limbs; LLW: Lower Limbs Weakness; ULW: Upper Limb Weakness; LLN: Lower Limb Numbness; IMB: Imbalance; B/L: Bilateral; LB: Lower Back; N/P: Numbness and Pain; N/T: Numbness and Tingling; Abd. N: Abdominal Numbness; WD: Walking Difficulty; W: Weakness; Pts: Patients; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-analyses; STMC: Sheikh Tahnoon Bin Mohammed Medical City.

Introduction

Obesity is a major global health issue affecting populations with a body mass index (BMI) over 30 kg/m^2. Despite considerable efforts towards non-surgical weight management strategies, long-term success rates remain inconsistent. This inconsistency has increased the use of bariatric surgery as a more effective intervention for weight control [1]. However, bariatric surgery is associated with inherent risks, including various neurological complications. Vitamin deficiencies, particularly B1 and B12, are common post-surgical sequelae that may lead to debilitating neurological effects, such as GBS [2]. GBS, a rare but potentially severe neurological condition, has been reported after bariatric surgery, with an estimated incidence of 0.06% (5.9 cases per 10,000 surgical procedures) [3,4]. Notably, GBS shares clinical features with thiamine deficiency, including prolonged vomiting, weakness, and hyporeflexia [3-5]. Delayed diagnosis and treatment of both conditions can significantly worsen long-term outcomes [6]. Therefore, the precise and timely diagnosis of GBS following bariatric surgery is vital to minimizing morbidity and mortality [6]. Limited information exists regarding the relationship between nutritional deficiencies, GBS, and post-bariatric surgery. This review explores the factors contributing to the risk of GBS after bariatric surgery. The findings of this study will, in turn, aid in designing optimal management strategies for GBS in patients after bariatric surgery.

Materials and Methods

The systematic review assessing the factors contributing to the risk of GBS following bariatric surgery was conducted using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines, which are a set of standards for reporting systematic reviews and meta-analyses. Searches in the Cochrane database with the keywords “GBS post-bariatric surgery” and “Complications Bariatric Surgery” yielded unsatisfactory results. Subsequently, searches were performed using the exact keywords in the PubMed and Google Scholar databases [7]. Inclusion criteria encompassed case reports and case series published in English that described adult GBS cases with a confirmed history of bariatric surgery (gastric sleeve or bypass) from January 2002 to January 2023. Incomplete studies published in other languages or lacking confirmation of bariatric surgery history were excluded. Titles, abstracts, and full texts were independently reviewed by two reviewers (one author and a volunteer). Both authors agreed on a data extraction form piloted with one report. Due to the limited number of reports identified, extraction was conducted by both authors of the study. Furthermore, to compare the literature data with the GBS cases presented at the hospital, the bariatric surgery registry was accessed and searched for all patients who underwent bariatric surgery [7], utilizing the International Classification of Diseases (ICD-10) G61.0 to gather the primary diagnosis data [8].

Results and Discussion

A total of 367 records from the PubMed and Google Scholar databases were identified through keyword searches. Duplicates (39/367, 10%) and records discarded for title/abstract reasons (41/367, 11%) were removed, resulting in 287 records for screening. The screening process eliminated incomplete records (134/287, 46%) and records that were neither case series nor case reports (32%, 92/287). The remaining sixty-one records underwent eligibility assessment; those not in English (34%, 21/61), published before 2002 (31%, 19/61), and those with unknown study outcomes (14%, 9/61) were further excluded. The final evidence synthesis produced 12

records detailing 33 cases of GBS following bariatric surgery (Figure 1). The synthesis of data from the databases indicated that the most frequent association was between sleeve gastrectomy and GBS. Of 33 patients, twenty-three (69.6%) had undergone sleeve gastrectomy (Table 1). The mean age of the patients was 27.2 ± 8.7 years, and the mean BMI before surgery was 49.5 ± 8.1. The onset of GBS varied from a few days or weeks to up to 3 months after surgery; however, detailed onset timelines were unavailable for all cases. The majority of patients were female (23/33, 69.6%). Male patients made up 30% (10/33) of the total patient population with GBS following bariatric surgery. Neurological deficits primarily included motor weakness in all cases (100%), followed by sensory symptoms such as paresthesia and/or sensory loss in 24 patients (24/33, 73%) and autonomic dysfunction in 5 patients (15%). GBS types were predominantly AMSAN (9/33, 27%), followed by AMAN (7/33, 21%), while the GBS subtype was not clearly defined for 15 patients (45.5%). Micronutrient deficiencies, including those of Vitamins B1, B6, B12, and E, were consistently observed, often alongside multivitamins. IVIg treatment was administered to 12 patients (36.6%), accompanied by multivitamins, mineral supplementation, and physiotherapy. Therapeutic plasma exchange (TPLEX) and intubation were performed in one case. The spectrum of clinical prognosis indicated that nearly one-fourth of the cases recovered completely (8/33, 24.5%), while the remaining 75% of patients achieved partial recovery with residual weakness and gait disturbance.

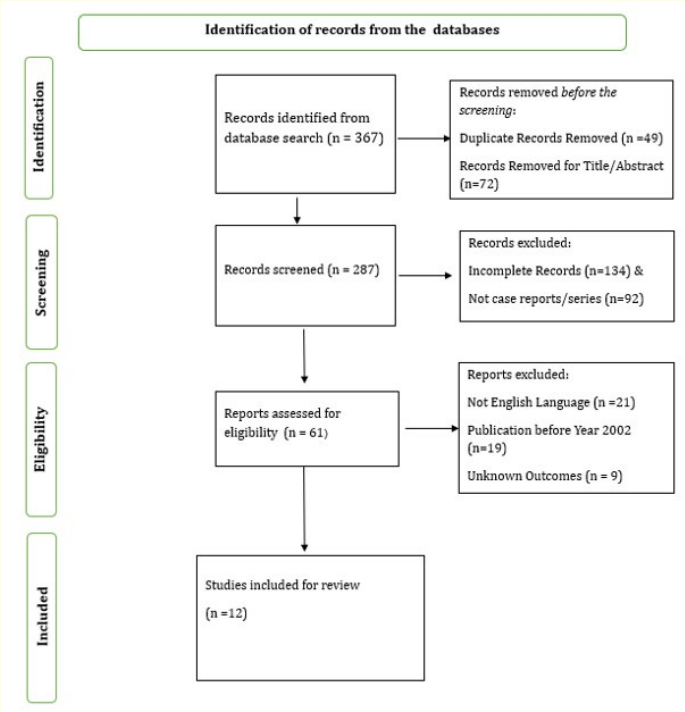

Figure 1: *PRISMA flow chart for assessing risk of GBS post bariatric surge.*

First Author	Year	Ref	Sex	Age	BMI	Type of Surgery	Clinical Presentation	Neurological Exam	GBS type	Treatment	Outcome
Aljthalin	(2022)	[6]	M F	21 23	62.1 39.6	Distal Gastrectomy Gastroduodenal anastomosis Sleeve gastrectomy	LLW, Numbness, burning, and IMB. Dysphagia, dyspnea, B/L LLW, and IMB	UL: DTR, MP, MT -normal LL: foot drop MP: 4/5 MT: flaccid DTR: absent SS: decrease pinprick. AS: no MP: UL Rt 3/5; Lt 2/5; LL 0/5 bl. MT: flaccid all limb DTR: absent SS: decreased sensation AS: yes	AMAN AMSAN	IVIg, PT IVIg + PT Ventilation + Tracheostomy	Full recovery Partial recovery
Ates	(2020)	[7]	M	21	NA	Sleeve gastrectomy	LLW	MP: UL 3/5, LL 2/5 DTR: absent AS: no	AMAN	IVIg, Vitamins	Full recovery
Sahin	(2019)	[8]	F M	27 19	59.7 50.5	Sleeve gastrectomy. Sleeve gastrectomy	B/L feet and LB burning, LLW N/P in legs and hands, LLW	MP: distal LL 4/5 DTR: areflexia in LL. AS: no MP: Distal symmetric paresis in both UL and LL 3/5 DTR: absent in LL	AMSAN AMSAN	IVIg, IM Vit B IVIg, TPLEX, Vit B12	Partial recovery Full recovery
Alshareef	(2019)	[9]	10F 3M	Mean 29.8	Mean41.9	Sleeve gastrectomy (11), Bypass (1), Balloon (1)	All with acute or subacute B/L ascending W	6 proximal W, 7 distal W, 7 ULW 2 B/L VII palsy 1 weak neck flexion 11 sensory W 2 respiratory failures	GBS type not defined	6 pts IVIg. all MVT iv; 2 pts admitted to ICU	All regained ability to ambulate, 8 independent walkers, 4 walking with limits.

Ghonim	(2019)	[4]	F	31	NA	Not available	B/L LLW and numbness	Lower Limbs DTR: absent SS: sensory loss to all modalities, AS: sinus tachycardia.	AMSAN	IVIg, Thiamine	Significant improvement
Sunbol	(2018)	[10]	F	20	42	Sleeve gastrectomy	B/L ascending LLN, followed by LLW, severe leg pain, choking, hoarseness, dyspnea dysphagia, constipation.	MP: reduced both proximal and distal muscle power. DTR: decreased in LL SS: decreased pinprick up to L1, impaired proprioception.	AMAN	ICU admission. IVIg, MVT, Selenium, + PT/OT.	Full recovery
			F	36	NA	Sleeve gastrectomy	Ascending weakness, LLN-> LLW-> pain.	MP: Reduced in both UL and LL proximal and distal muscles. DTR: decreased in LL	AMAN	MVT IV + PT	Persistent weakness
			F	22	43	Sleeve gastrectomy	Memory impairment, and hoarseness.	MP: Decreased in LL. DTR: absent in LL decreased in UL SS: decreased up to knees	AMAN	IVIg, Vit B, D, PT	Good condition
Shehabeldin	(2017)	[11]	F	45	NA	Sleeve gastrectomy	LLW, N/T-> ULW, N/T + Disorientation, inattention, Staring spells.	MP: weakness DTR: Absent MT: hypotonia SS: paresthesia	Axonal GBS	IVIg, MVT + PT	Full recovery

Demirvurek	(2018)	[12]	3 M 2 F	Mean: 32.2	Mean 52.2	Sleeve gastrectomy	2 pts foot drop. 3 pts LLW-> ULW.	MP: 2 pts foot drop MP: 3 pts all limbs weakness DTR: absent SS: not mentioned	2 AMAN 1 AIDP 2 Peroneal neuropathies	IVIg, MVT, Minerals, PT	Improvement in all
Yasawy	(2017)	[13]	F F	21 25	58 41	Sleeve gastrectomy Sleeve gastrectomy	B/L distal paresthesia, pain, WD-> UL Paresthesia, B/L LLW-> chair bound.	MP:4/5 in all limbs DTR: absent SS: loss in gloves and stocking distribution, impaired proprioception. MP: 4/5 UL; 3/5 LL DTR: absent SS: distal sensory loss and impaired proprioception in all extremities.	AMSAN AMSAN	Vitamin B1, B12, D, E, Folic acid, PT Vit B1, B12, D, E, Folic acid, Ca, PT	Walking with minimal support Walking with minimal support
Bodunova	(2015)	[2]	M	34	46.2	Roux-en-Y gastric bypass	Abd.N, cooling feet, Ascending B/L LLW, B/L distal forearm W.	MP:2/5 proximal LL 3/5 at distal LL DTR: absent in LL, Decreased in UL SS: pain and vibration sense decreased	AMSAN	MVT; ferrous sulphate	Complete recovery after 6 months

Aluka	(2009)	[3]	F	40	60	Roux-en-Y gastric bypass	Rapid B/L LL cramping, burning->inability to walk/stand	MP: 3/5 LL DTR: absent SS: decreased all modalities from mid thigh to distal limbs	AMSAN	Gabapentin, + PT	Gradual improvement and complete resolution after 6 months
Machado	(2006)	[14]	M	25	48	Sleeve gastrectomy	Paresthesia medial B/L thighs-> feet	MP: Severe weakness mainly at proximal LL DTR: normal in UL Decreased in LL Absent in Achilles tendon. SS: hypoesthesia touch and pin prick in both legs and feet.	AMSAN	IVIg; Vitamin B1, B6	Full recovery over few weeks.

Table 1: *Systematic review of GBS case reports following bariatric surgery (n = 33).*

The bariatric surgery Tawam hospital registry identified only two cases of GBS among 3,600 patients who underwent bariatric surgery at the hospital during the period. In comparison, the two cases involved a 59-year-old and a 23-year-old female, with BMIs of 45 kg/m^2 and 40.08 kg/m^2, respectively, who had laparoscopic Roux-en-Y gastric bypass and sleeve gastrectomy. Both patients developed GBS-variants as Acute Motor Axonal Neuropathy as well as Acute Motor and Sensory Axonal Neuropathy. The onset of GBS occurred a few weeks after bariatric surgery. The patients initially presented with general weakness and lower limb neuropathic pain. Treatment included IVIg and physical therapy for both patients, although the 23-year-old also received therapeutic plasma exchange and ventilation due to developed respiratory failure. Both patients experienced partial recovery, with residual upper and lower limb weakness, foot drop, and subsequent gait disturbances (Table 2).

Case	Age	Sex	BMI	Surgery	Clinical Symptoms	Neurological Exam	GBS type	Treatment	Outcome
Case 1.	59	F	45	Gastric bypass surgery	Generalized weakness.	DTR: absent MP&MT: Flaccid quadriparesis SS: Hyperesthesia AS: no	AMAN	IVIg, MVT iv. PT.	Partial recovery: residual UL/LL weakness, hindering independent gait
Case 2.	23	F	40	Sleeve gastrectomy	Generalized weakness, LL neuropathic pain.	DTR: diminished MP&MT: Flaccid quadriparesis SS: Paresthesia AS: yes	AMSAN	IVIg, TPLEX, Ventilation, PT	Partial recovery: gait impairment due to bilateral foot drop (steppage).

Table 2: *Bariatric Surgery and GBS cases harvested from the Hospitals Bariatric Surgery Registry (n = 2).*

Discussion

Guillain-Barre syndrome is a rare but serious autoimmune disorder characterized by muscle weakness and paralysis. Although the risk of GBS remains unclear, several factors-including infections, vaccinations, and surgery-have been linked to its development. Emerging evidence suggests that bariatric surgery may also pose a potential risk factor for GBS, making it essential for patients and healthcare providers to exercise careful consideration. Post-surgical GBS is a rare neurological condition. The exact incidence is uncertain due to variability in reported rates in the literature, which arises from differences in the number of patients studied. Various studies have explored the relationship between GBS and bariatric surgery, indicating an increased risk of GBS among patients who undergo bariatric surgery compared to the general population. In a study involving 451 post-bariatric surgery patients, 15 developed neurological complications, and two of those were diagnosed with GBS (0.44%), translating to approximately four in 1,000 patients. While the risk remains relatively low, the possibility of GBS necessitates close monitoring for early signs and prompt medical intervention.

Sleeve gastrectomy and gastric bypass are the two most common bariatric procedures, both linked to GBS cases post-surgery. Our results indicated a stronger association between GBS and post-sleeve gastrectomy; nearly 70% of sleeve gastrectomy patients had GBS (Table 2). The onset of GBS after bariatric surgery shows variability; some cases develop within weeks, while others appear years later, highlighting the need for long-term follow-up [17-20]. GBS can impact both men and women who undergo bariatric surgery [18-20]. Our study found a higher percentage of GBS in female patients after sleeve gastrectomy (Table 1). This might be because females are more likely to seek body-shaping surgeries compared to their male counterparts. However, there is no conclusive evidence suggesting a sex-based predisposition to GBS development after bariatric surgery. The specific neurological deficits linked to post-bariatric surgery GBS include weakness in the limbs and respiratory muscles, numbness and tingling in the limbs, and occasionally in the face [19-21].

Reports indicate that bariatric surgery can induce various physiological changes, including hormonal stress, which triggers an inflammatory response, damages the myelin sheath surrounding nerves, and causes alterations in the gut microbiome [22]. These changes may initiate an autoimmune response, potentially leading to GBS and an increased susceptibility to Campylobacter jejuni and other bacterial infections [23-25]. Micronutrients and vitamin deficiencies can contribute to developing GBS after bariatric surgery. Post-surgery, malabsorption of nutrients and vitamins can occur, particularly in the early stages, leading to deficiencies in essential micronutrients and vitamins, including vitamins B12 and D, iron, calcium, and magnesium [26-29]. A deficiency in vitamin B12 can cause peripheral neuropathy and mimic GBS symptoms. Furthermore, other micronutrient deficiencies can impair immune function.

The risk of GBS following bariatric surgery remains uncertain, although several hypotheses exist. A prevailing theory suggests that bariatric surgery may trigger an autoimmune response in susceptible individuals due to the significant changes it induces in the immune system and gut microbiome [3,33]. Alterations in the gut microbiome can lead to dysbiosis linked to autoimmune diseases, including GBS [32,33]. Additionally, bariatric surgery can modify hormone and cytokine levels, affecting the immune system. Increased ghrelin levels after bariatric surgery-a hormone with immune-modulatory effects-may provoke an autoimmune response in susceptible individuals [31-33].

The management of GBS following bariatric surgery employs strategies similar to those for non-surgery-related GBS, aiming to reduce symptom severity, accelerate recovery, and prevent long-term complications. Treatment typically includes a combination of immunotherapy, intravenous immunoglobulin (IVIg), and therapeutic plasma exchange (TPLEX), the primary pathophysiological therapies for GBS. Immunotherapy usually accompanies various symptomatic and supportive treatment strategies, such as mechanical ventilation for respiratory support, pain management, and physical therapy to maintain mobility and function during recovery [34]. Additional management options encompass nutritional correction, physio-occupational therapies, and psychological and emotional support. The prognosis of GBS post-bariatric surgery is generally favorable with prompt and appropriate treatment. Most patients recover partially, but regaining strength and function can take several weeks to months.

Sometimes, patients may experience residual weakness or other long-term complications, but the general outlook is positive. Overall, the potential benefits of bariatric surgery outweigh the relatively low risk of GBS for suitable candidates [35]. However, it is crucial for patients considering bariatric surgery to discuss the potential risks and benefits with their healthcare provider to determine the best treatment for their health needs and preferences.

Conclusion

The systematic review identified 35 cases of GBS following bariatric surgery, highlighting the risk of developing GBS postoperatively. Although the overall incidence appears low, the reported cases provide valuable insights. The sleeve gastrectomy procedure is the most common risk factor for patients and is associated with the onset of GBS. The timing of GBS onset varied significantly, underscoring the need for caution during the postoperative period. Neurological deficits primarily manifested as motor weakness, sensory deficits, and autonomic dysfunction. Micronutrient deficiencies, particularly in vitamins B1, B6, B12, and E, were noted, emphasizing the importance of nutritional management in the care plan. Despite varying prognoses, most patients experienced partial recovery, although with lingering symptoms. The findings of this study stress the necessity for clinicians to remain vigilant regarding the risk of GBS in bariatric surgery patients. Early diagnosis and adjustments to the care plan that include micronutrients and minerals may improve outcomes and reduce potential complications.

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Conflict of Interest

The authors declare that no conflict of interest exists.

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