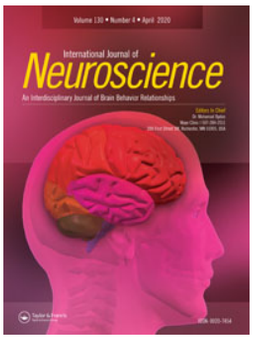

International Journal of Neuroscience

ISSN: 0020-7454 (Print) 1543-5245 (Online) Journal homepage: www.tandfonline.com/journals/ines20

Peroneal neuropathy and bariatric surgery: untying the knot

Mohamad Y. Fares, Zakia Dimassi, Jawad Fares & Umayya Musharrafieh

To cite this article: Mohamad Y. Fares, Zakia Dimassi, Jawad Fares & Umayya Musharrafieh (2020) Peroneal neuropathy and bariatric surgery: untying the knot, International Journal of Neuroscience, 130:4, 417-423, DOI: 10.1080/00207454.2019.1694926

To link to this article: https://doi.org/10.1080/00207454.2019.1694926

INTERNATIONAL JOURNAL OF NEUROSCIENCE
2020, VOL. 130, NO. 4, 417–423
https://doi.org/10.1080/00207454.2019.1694926

Taylor & Francis
Taylor & Francis Group

ORIGINAL ARTICLE

Peroneal neuropathy and bariatric surgery: untying the knot

Mohamad Y. Fares[a,b], Zakia Dimassi[a], Jawad Fares[c] and Umayya Musharrafieh[d]

[a]Faculty of Medicine, American University of Beirut, Beirut, Lebanon; [b]Neuroscience Research Center, Faculty of Medical Sciences, Lebanese University, Beirut, Lebanon; [c]Department of Neurological Surgery, Feinberg School of Medicine, Northwestern University, Chicago, IL, USA; [d]Department of Family Medicine, American University of Beirut Medical Center, Beirut, Lebanon

ABSTRACT

Purpose: Peroneal neuropathy is a neurological complication of bariatric surgery (BS) that can impair the functional capacity of the presenting patient and reduce quality of life. The aim of this paper is to explore and offer medical insight into the presentation, etiologies, and therapeutic modalities of peroneal neuropathy following BS.

Methods: We explored PubMed/Medline for cases involving peroneal neuropathy as a complication of BS. The search included all articles published from database inception until April 25, 2019. Only articles published in English were included. Clinical information and demographics extracted from the reported studies were analyzed and assessed.

Results: Only 9 studies met our criteria, with a total of 21 cases ($n = 21$). Females dominated in 14 cases (67%). Ages ranged from 12 to 53 years with mean age being 36. All cases reported pain, numbness and weakness in their lower limb. Gastric bypass was the most common procedure with 9 cases (43%). All cases witnessed loss of a large amount of weight following BS. Amount of weight lost per month ranged from 2.7 kg/month to 19 kg/month. Electrodiagnostic studies were used in 18 cases (86%). Of all the cases presented, 12 (57%) underwent surgical treatment, 7 (33%) underwent conservative treatment, and 2 (10%) resolved spontaneously. All patients reported improvement of symptoms.

Conclusion: Better knowledge of the demographics and clinical characteristics of peroneal neuropathy following BS will help in achieving earlier diagnosis and avoiding invasive therapeutic modalities. Guidance with respect to weight reduction is pivotal in deterring similar neurological complications.

ARTICLE HISTORY
Received 2 June 2019
Revised 30 October 2019
Accepted 11 November 2019

KEYWORDS
Bariatric surgery; peroneal neuropathy; neurological complication; obesity; systematic review

Introduction

Obesity is a deleterious condition that constitutes a risk factor for cardiovascular diseases, cancer, osteoarthritis, hypertension, diabetes mellitus and stroke, and is consequently associated with increased morbidity and mortality [1–10]. The prevalent spread of obesity constitutes a deleterious issue that requires major attention worldwide [11]. Bariatric surgery (BS) offers a highly efficient long-term solution to obesity in terms of weight loss, reduction of mortality, decreasing risk of severe comorbidities, and improving quality of life [12]. Over time, BS has become more popular among physicians and patients due to novel techniques that are less invasive and produce better outcomes [12]. As a result of the efficacy of these procedures, many patients exhibit huge weight loss over a short period of time, and consequently, witness drastic health and lifestyle changes.

Even though bariatric procedures have proved to be really helpful and efficient, they do produce many post-operative complications, some of which being neurological [13]. One neurological complication of bariatric practices is peroneal neuropathy, often due to nutritional deficiencies post-surgery or nerve compression [14–17]. There exists a prominent variation in the presentation of peroneal neuropathy following BS, and as a result, therapeutic plans and modalities are catered to the individual case. While some cases may require surgery, others may only require conservative treatment to alleviate symptoms. Few documented cases exist in the medical literature that describe peroneal neuropathy following BS (Table 1) [16–25]. The aim of this paper is to explore the diagnostic, clinical, and pathologic characteristics of this condition, in an aim to formulate proper therapeutic modalities based on a systematic review of the literature.

CONTACT Umayya Musharrafieh um00@aub.edu.lb Department of Family Medicine, American University of Beirut Medical Center, Beirut, Lebanon
Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/ines.

Table 1. Documented cases of peroneal neuropathy due to bariatric surgery in the medical literature.

Author	Year	Background	Presentation and Findings	Prognosis
Elias et al. [16]	2006	53-year-old female undergoes bariatric surgery and loses 51.7 kg over 12 months	Bilateral peroneal neuropathies developed over time. These were confirmed using electromyography	Decompressive surgery at the level of the knee improved symptoms
Gumus et al. [17]	2007	12-year-old male undergoes gastric bypass and lost 40 kg over 4 months	4 months post-surgery, the patient presented with bilateral peroneal neuropathy. Nutritional investigation revealed a decrease in folate intake	Folate therapy was started and the patient recovered after 2 months
Weyns et al. [18]	2008	Nine patients underwent bariatric surgery (5 gastric banding and 4 gastric bypass procedures) and lost a large amount of weight over a short period of time. Mean weight loss for the patients was 45 kg, and mean period of time was 8.6 months	The patients developed persistent foot drop. Electromyography confirmed peroneal neuropathy	Neurolysis of the peroneal nerve at the level of the fibular head resolved the nerve palsy
Menezes et al. [19]	2008	27-year-old female underwent gastric bypass and lost 24 kg in 2 months	Patient developed throbbing pain and burning sensation in her limbs. Electroneuromyography confirmed peroneal neuropathy	A course of physical therapy was recommended
		45-year-old female underwent gastric bypass and lost 38 kg in 2 months	Patient developed numbness, tingling, and pain on her hands and feet. Electromyogram showed peroneal neuropathy	A course of physical therapy was implemented, and the patient received nutritional orientation
		50-year-old male underwent bariatric surgery and lost 50 kg in 6 months	Patient developed pain, numbness, and weakness in his limbs. Electroneuromyography revealed peroneal neuropathy	A course of physical therapy was implemented, and the patient received nutritional orientation
Prado [20]	2010	49-year-old male with a BMI of 36.2 kg/m^2 underwent vertical gastroplasty with cholecystectomy and lost 45 kg in 11 months	During the post-operative period, he complained of bilateral weakness in his legs, and loss of right foot dorsiflexion strength	Symptoms persisted for 45 days and then resolved spontaneously
		22-year-old female with a BMI of 39.5 kg/m^2 underwent vertical gastroplasty and lost 38 kg in 6 months	During the 6 months period, she complained of muscle weakness in her legs. Upon examination, she showed complete loss of right foot dorsiflexion strength	Symptoms resolved spontaneously three weeks later
Lin and Lin [21]	2011	24-year-old female underwent gastric bypass and lost 32 kg over a period of 4 months	At 5 months follow-up, she developed thiamine deficiency, bilateral wrist drop, foot drop, and marked distal limb atrophy. Electromyography revealed the presence of sensorimotor axonal polyneuropathy	Two months after the patient was bed-ridden, she was started on intravenous vitamin replacement therapy and witnessed mild improvement
Milants et al. [22]	2013	45-year-old male underwent gastric bypass and lost 64 kg over a period of 10 months	Few months later, the patient sustains severe right peroneal nerve palsy, and a subsequent contralateral left peroneal nerve palsy Electromyography further confirmed the findings	Patient underwent decompressive surgery to both nerves. Postoperative course was favorable
Ramos-Levi et al. [23]	2013	30-year-old female with long history of obesity underwent vertical gastroplasty and lost 44.3 kg over 6 months	At 6-months post-surgery, she presented with right lower-limb paresthesias and foot drop. Electromyography revealed right peroneal neuropathy at the head of the fibula	Diet was improved and oral vitamin and mineral supplementation was upheld. A year later, the patient achieved a stable weight, and her neurological symptoms subsided
		45-year-old male with a long history of obesity, medication-controlled hypertension and smoking underwent duodenal switch and lost 45.7 kg over 6 months	At 6-months post-surgery, patient presented with numbness of the right foot and erroneous gait. Electromyography revealed evidence of peroneal neuropathy	Physical therapy was recommended and symptoms disappeared 6 months later
Al-Sulaiman [24]	2016	18-year-old female underwent sleeve gastrectomy and lost 26 kg over 3 months	At 3 months post-surgery, the patient presented with weakness in both lower limbs, associated with a burning sensation. Electromyography and nerve conduction studies confirmed peripheral neuropathy of the peroneal nerve	The patient was prescribed multivitamin supplements including folate and other micronutrients

Materials and methods

Search strategy and selection criteria

To explore the different cases of peroneal neuropathy due to BS reported in the literature, sources were identified by searching MEDLINE and PubMed for English language articles published from database inception until April 25, 2019. We used the following search terms for peroneal neuropathy: 'peroneal neuropathy' OR 'peroneal nerve injury' OR 'foot drop' OR 'peroneal palsy', and the following terms for BS: 'bariatric surgery' OR 'weight loss surgery'. We used the Boolean operator AND to combine the search terms of peroneal neuropathy and that of BS. Additional studies were identified from the reference lists of retrieved articles. Only observational studies, interventional trials and case reports were included (Figure 1).

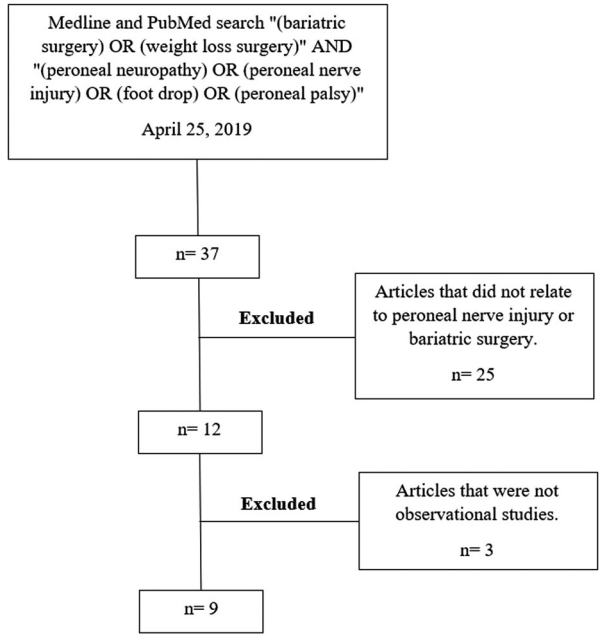

Figure 1. Article selection process.

Data collection

The authors critically reviewed the articles and included as appropriate to provide readers with a current overview on the presentations, etiologies, and therapeutic modalities of peroneal neuropathy following BS. Information was acquired from the final data set on the presentation, diagnosis, and treatment of peroneal neuropathy. Moreover, clinical and demographic characteristics such as age, sex, weight loss, and prognosis were recorded.

Table 2. Demographic and clinical characteristics of the cases under study.

		N	Percent (%)
Sex	Male	7	67
	Female	14	33
Procedure	Gastric bypass	9	43
	Gastric banding	5	24
	Vertical gastroplasty	3	14
	Gastric sleevectomy	1	5
	Duodenal switch	1	5
	Unspecified	2	10
Diagnostic Tools	EMG or ENMG	18	86
	Nutritional assessment	1	5
	Unspecified	2	10
Treatment	Surgical	12	57
	Non-surgical	7	33
	No treatment	2	10

Results

Only 9 studies met our criteria (Figure 1). These studies reported a total of 21 cases of peroneal nerve injury following BS ($n = 21$). The clinical and demographic characteristics of the cases reported were analyzed and assessed (Table 2**)**. Of the 21 cases reported, 14 cases (67%) affected females while 7 cases (33%) affected males. Ages ranged from 12 to 53 years, and mean age was 36 years.

All cases underwent BS and reported pain, numbness, and weakness in the lower limb ($n = 21$). Gastric bypass was the most common procedure with 9 cases (43%), followed by gastric banding with five cases (24%), and vertical banded gastroplasty with 3 cases (14%). One case (5%) underwent a duodenal switch procedure and one case (5%) underwent sleeve gastrectomy. Two cases (10%) did not specify what procedure was undertaken.

All cases reported loss of large amount of weight in a short period of time. Amount of weight loss ranged from 20 to 74 kg, while period of weight loss ranged from 2 to 18 months. The amount of weight lost per month ranged from 2.7 kg/month to 19 kg/month with an average of 7.4 kg/month. In addition, 18 cases (86%) required electromyography (EMG) or electroneuromyography (ENMG) to confirm findings, while 1 case (5%) relied solely on nutritional assessment. Two cases (10%) did not specify whether EMG or ENMG was used to confirm diagnosis.

Treatment modalities were either surgical or non-surgical. Surgical treatment was opted in 12 cases (57%), while non-surgical treatment was opted in 7 cases (33%). Two cases did not undergo any treatment (10%). All patients had positive prognosis and reported improvement of their symptoms (100%).

Bariatric surgery procedures

BS procedures to reduce weight have been applied for half a century and have gained worldwide growth due to the increasing prevalence of obesity [26]. These procedures achieve weight loss through restrictive and malabsorptive processes: restrictive processes include removing a portion of the stomach to reduce its size, while malabsorptive procedures include resecting and bypassing parts of the small intestine and the stomach, and rerouting it to a small stomach pouch [27–29]. The most prominent procedures used nowadays are: gastric bypass, gastric banding, vertical gastroplasty, sleeve gastrectomy and duodenal switch.

Gastric bypass is a restrictive-malabsorptive bariatric procedure that is considered the most commonly used worldwide [27]. This procedure reduces stomach size and bypasses part of the bowel to achieve a markedly lower stomach volume [28]. Several modifications and variations evolved over the years, like reduction in gastric pouch size, complete gastric transection, and application of a Roux-en-Y [29]. Gastric banding is a procedure introduced in the 1980s that constricts the stomach using an inflatable silicon band placed around the top portion of the stomach. This slows and restricts the quantity of food consumed by the patient, hence causing an earlier feeling of satiety. Later modifications saw the introduction of adjustable devices and better techniques that helped increase this procedure's popularity [30,31]. Gastroplasty is a restrictive procedure first conducted in the 1970s; this procedure later developed into vertical banded gastroplasty (VBG) and became popular in the 1990s [31]. VBG uses a band and staples to reduce stomach size and create a small stomach pouch, thereby decreasing eating consumption. Food can flow into the rest of the gastrointestinal system through a small hole at the bottom of the stomach pouch. Sleeve gastrectomy is a restrictive procedure that was derived from the concept of VBG to be used in high risk patients [32]. This procedure removes a large portion of the stomach along the greater curvature, resulting in a sleeve or tube-like structure [32]. Similar to other procedures, this limits the amount of food taken and illicits hormonal changes that assist in weight loss. A duodenal switch is a less common restrictive-malabsorptive procedure [31,32]. It involves reducing the stomach size by around 80% and bypassing the majority of the intestine by connecting its end portion to the duodenum near the stomach [31,32]. Duodenal switch is considered a very reliable and long lasting BS procedure for weight loss.

BS is considered the most effective solution for the morbidly obese population [28]. These procedures markedly reduce body weight, reverse the comorbidities of obesity, and improve quality of life [25]. Nevertheless, the massive weight loss witnessed following BS entails possible complications that can present hurdles to the patient's health and satisfaction.

Presentation and diagnosis

Neurological complications following BS can present prominent functional impairment in the patient. These complications include: burning feet syndrome, peripheral neuropathy, myotonic syndrome, Wernicke-Korsakoff encephalopathy, and lumbosacral plexopathy [14]. Out of these neurological complications, peripheral neuropathy stands as the most prevalent, with some studies presenting incidence rates reaching up to 16% of BS patients [14].

Three patterns of peripheral neuropathy arise following BS: sensory-predominant polyneuropathy, mononeuropathy, and radiculoplexus neuropathy [14]. The sensory-predominant polyneuropathy pattern presents symptoms of symmetric and sensory nature, which may include signs of weakness and numbness in the hands or feet [14]. The mononeuropathy pattern presents with asymmetric symptoms at common sites of nerve entrapment, like the median nerve at the wrist and the peroneal nerve at the knee. Radiculoplexus neuropathy can affect both the lumbosacral and cervical regions; it presents asymmetrically in the beginning and progresses with unilateral symptoms [14].

Peroneal nerve injury or peroneal neuropathy occurs when the pattern of peripheral neuropathy affects the common peroneal nerve. When that happens, numbness and weakness arise in the affected leg and a manifestation of 'foot drop' is observed [23]. As with other pathologies, diagnosis can be made with physical examination and confirmed with electrodiagnostic studies [20,33]. Pathologically, the most prominent feature is axonal degeneration [34].

Peroneal neuropathy can pose as a functional limitation to the patient and can present with a plethora of debilitating symptoms. Taking careful clinical history is pivotal in evaluating the severity of the condition and detecting possible etiologies. Risk factors often include a great amount of weight loss, rapid rate of weight loss, chronic gastrointestinal symptoms, novel unguided dietary habits, reduced levels of serum albumin and transferrin, decreased calcium and vitamin supplementation and postoperative complications [14].

Initially, patients may complain of pain at the site of compression, foot drop, slapping gait and

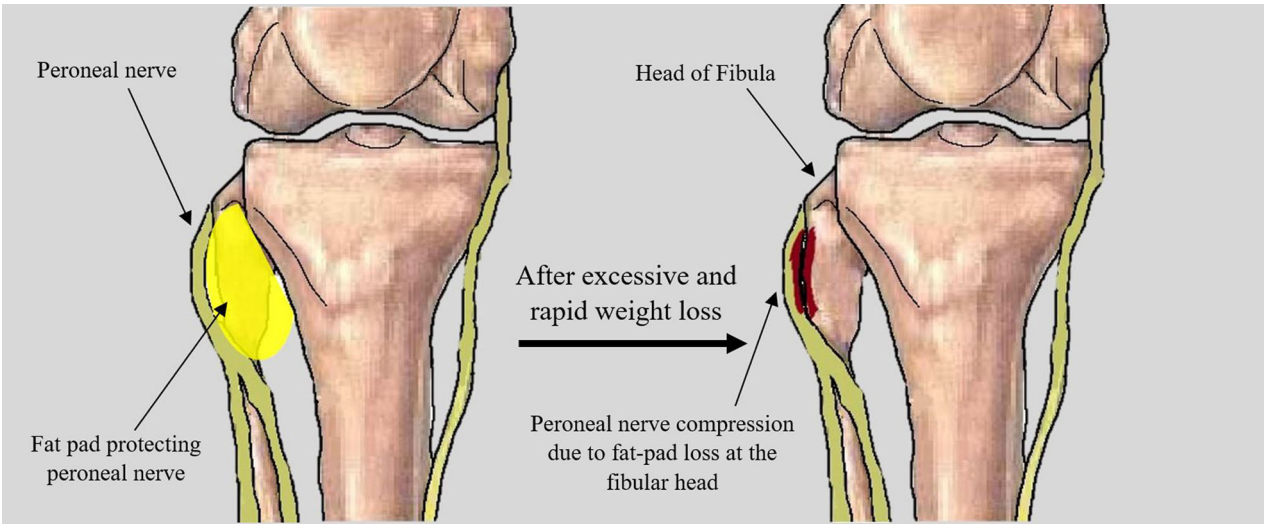

Figure 2. Loss of protective fat pad due to rapid and excessive weight loss leads to the compression of the peroneal nerve at the level of the fibular head.

paresthesias, with pain symptoms usually preceding sensory symptoms [35,36]. Further investigation usually shows impaired toe dorsiflexion, weak foot dorsiflexion and eversion, and sensory loss that can encompass the entire dorsal foot and lateral leg [20,21,23]. All these manifestations can significantly diminish the quality of life of the presenting patient.

Electrodiagnostic examinations like nerve conduction studies, EMG and ENMG, are of paramount importance in confirming the diagnosis of peroneal neuropathy, excluding alternative diagnoses, and predicting prognosis [36]. Nerve conduction studies can provide high efficacy in detecting and analyzing peroneal nerve insults [19, 36]. If the lesion is due to demyelination, a focal slowing or conduction block can be witnessed, whereas if the lesion is due to axonal degeneration, a decrease in the amplitudes of action potentials would be observed [36]. EMG and ENMG are significantly helpful as well, and aid in confirmation of the diagnosis and localization of the lesion. Muscles that are commonly examined include one muscle innervated by the superficial peroneal nerve, two muscles innervated by the deep peroneal nerve, the tibialis posterior, the medial gastrocnemius, and the short head of the biceps femoris [36,37]. In case any of the examined muscles show an abnormal finding, muscles supplied by the nerve root L5 and not the peroneal nerve are examined to exclude sciatic neuropathy, radiculopathy, and lumbosacral plexopathy [37].

Etiologies

Two etiologies arise when trying to explain the development of peroneal neuropathy following BS: peroneal nerve compression due to fat-pad loss at the fibular head, and nutritional and vitamin deficiencies. Excessive weight loss at a rapid pace could compromise the fat padding surrounding the fibular head. This fat-pad loss leaves the nerve vulnerable, due to its superficial nature, and can thus cause impingement and compression (Figure 2) [35]. Nutritional and vitamin deficiencies can play a major role in pathogenesis as well [38,39]. Most commonly, these include deficiencies of thiamine, vitamin B12, vitamin E, vitamin D, and copper; nevertheless, thiamine deficiency is considered the chief nutritional cause of neuropathy post BS [40]. This deficiency is most commonly seen with chronic alcohol abuse, acquired immunodeficiency syndrome (AIDS), long-term parenteral nutrition, eating disorders, and weight reduction surgery [41]. Thiamine is absorbed in the small intestine, converted to thiamine diphosphate, and is subsequently involved in multiple essential processes including myelin sheath maintenance [39,41]. Excessive and rapid weight loss, without adequate vitamin and nutritional supplementation, can lead to the loss of thiamine; which in turn, can cause neuropathies such as the ones seen following BS. Given that the body stores contain only 20 days of thiamine, symptoms of thiamine deficiency would start to manifest around 3 weeks post-surgery.

It is important to know that these two etiologies are not mutually exclusive and are often both responsible for the development of peroneal neuropathy in BS patients. Nevertheless, clinical history and examination can help in identifying which of the two etiologies is more prominent. Peroneal neuropathy due to fat-pad loss often presents as a mononeuropathy following BS, where the symptoms are limited exclusively

to the peroneal nerve. On the other hand, when the cause is vitamin deficiency, the symptoms often present as polyneuropathy and may involve nerves other than the peroneal nerve [23]. Electrodiagnostic studies along with nutritional and vitamin assessment may further help in identifying the correct cause of the neuropathy.

Treatment

Therapeutic modalities for this condition should be specific to each individual case. However, two approaches have been proposed as the best choice for therapy: a conservative approach and a surgical approach [21]. The conservative approach includes physical therapy, and vitamin and nutrition supplementation to replenish any vitamin deficiencies [23]. In the case where symptoms remain persistent, surgery can be done to relieve pain and improve outcomes [16,22]. Surgical techniques and time of intervention differ according to the nature of the presenting case. Neurolysis often yields the best outcome when compared to other surgical techniques. End-to-end suture repair is considered preferable to graft repair, and shorter grafts provide better outcomes [36]. That being said, one should not delay treatment since the probability of irreversible neurological damage increases with time [21].

The importance of proper follow-up post BS should be highlighted. Proper nutritional guidance following surgery is associated with less complications and better outcomes [14]. Thiamine, vitamin B12 and copper should be a part of baseline metabolic work-up for patients undergoing BS, especially those who were on a diet prior to surgery [36]. It is essential that patients maintain their range of motion post-surgery to preserve the ability to ambulate [36]. In addition, close monitoring of the weight reduction process is necessary to ensure that the safety and health of the patient is not compromised. Even though peroneal neuropathy is not common, it poses as a huge limitation to the quality of life of the patient, and early diagnosis and intervention can deter the need for invasive therapeutic modalities.

Conclusion

Peroneal neuropathy is a neurological complication of BS that can hinder the functional capacity of the patient. The condition is often manifested with weakness in the affected lower limb, and consequently impairs activity and mobility. Fat-pad loss due to excessive weight reduction, and vitamin and nutritional deficiencies have been proposed as the main etiologies to this condition. Therapeutic modalities are case specific and include both a conservative and a surgical approach. Guidance with respect to weight reduction and nutritional intake following BS can be pivotal in preventing neurological complications like peroneal neuropathy from occurring.

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Jawad Fares http://orcid.org/0000-0002-5368-8764

References

[1] Borges JL, Miranda IS, Sarquis MM, et al.Obesity, bariatric surgery, and vitamin D. Journal of Clinical Densitometry. 2018;21(2):157–62.
[2] Smith KB, Smith MS. Obesity statistics. Prim Care. 2016;43(1):121–135.
[3] Khachfe HH, Salhab HA, Fares MY, et al. Probing the colorectal cancer incidence in Lebanon: an 11-year epidemiological study. J Gastrointest Cancer. 2019;17: 1–8.
[4] Fares MY, Salhab HA, Khachfe HH, et al. Breast cancer epidemiology among Lebanese women: an 11-year analysis. Medicina. 2019;55(8):463.
[5] Khachfe HH, Refaat MM. Bibliometric analysis of cardiovascular disease research activity in the Arab world. Int Cardiovasc Forum J. 2019;15: 8–11.
[6] Khachfe HH, Salhab HA, Fares MY, et al. Current state of hypertrophic cardiomyopathy clinical trials. Glob Heart. 2019;14(3):317–325.
[7] Khachfe HH, Sammouri J, Salhab HA, et al. Maternal mortality and health in the Arab World: A 25-year epidemiological study. J Obstet Gynaecol Res. 2019.
[8] Salhab HA, Fares MY, Khachfe HH, et al. Epidemiological Study of Lung Cancer Incidence in Lebanon. Medicina. 2019;55(6):217.
[9] Fares MY, Salhab HA, Khachfe HH, et al. Sports Medicine in the Arab World. Handbook of Healthcare in the Arab World. New York (NY): Springer, Cham. 2019.
[10] Salhab HA, Salameh P, Hajj H, et al. Stroke in the Arab World: A bibliometric analysis of research activity (2002–2016). eNeurologicalSci. 2018;13:40–45.
[11] Fares MY, Fares J, Baydoun H, et al. Sport and exercise medicine research activity in the Arab world: a 15-year bibliometric analysis. BMJ Open Sport Exerc Med. 2017;3(1):e000292.
[12] Landais A. Neurological complications of bariatric surgery. Obes Surg. 2014;24(10):1800–1807.
[13] Abarbanel JM, Berginer VM, Osimani A, et al. Neurologic complications after gastric restriction

surgery for morbid obesity. Neurology. 1987;37(2): 196–200.
[14] Thaisetthawatkul P, Collazo-Clavell ML, Sarr MG, et al. A controlled study of peripheral neuropathy after bariatric surgery. Neurology. 2004;63(8):1462–1470.
[15] Koffman BM, Greenfield J, Ali II, et al. Neurologic complications after surgery for obesity Muscle. Nerve. 2006;33(2):166–1676.
[16] Elias WJ, Pouratian N, Oskouian RJ, et al. Peroneal neuropathy following successful bariatric surgery: case report and review of the literature. JNS. 2006; 105(4):631–635.
[17] Gümüş H, Altural D, Per H, et al. Bilateral radial and peroneal neuropathy after bariatric surgery in a morbid obese adolescent. Eur J Paediatr Neurol. 2007; 11: 70.
[18] Weyns FJ, Beckers F, Vanormelingen L, et al. Foot drop as a complication of weight loss after bariatric surgery: Is it preventable?. Obes Surg. 2007;17(9): 1209–1212.
[19] Menezes MS, Harada KO, Alvarez G. Painful peripheral polyneuropathy after bariatric surgery. Rev Bras Anestesiol. 2008;58(3):252–259.
[20] Prado MP. Developed foot drop as a complication of bariatric surgery. Einstein (São Paulo). 2010;8(2): 232–234.
[21] Lin IC, Lin YL. Peripheral polyneuropathy after bariatric surgery for morbid obesity. J Fam Community Med.. 2011;18(3):162.
[22] Milants C, Lempereur S, Dubuisson A. Bilateral peroneal neuropathy following bariatric surgery. Neurochirurgie. 2013;59(1):50–52.
[23] Ramos-Leví AM, Matías-Guiu JA, Guerrero A, et al. Peroneal palsy after bariatric surgery; is nerve decompression always necessary?. Nutr Hosp. 2013;28: 1330–1332.
[24] Al-Sulaiman A. Acute painful polyneuropathy after bariatric surgery. Saudi J Med Med Sci. 2016;4(2):121.
[25] Juhasz-Pocsine K, Rudnicki SA, Archer RL, et al. Neurologic complications of gastric bypass surgery for morbid obesity. Neurology. 2007;68(21): 1843–1850.
[26] Mason EE, Ito C. Gastric bypass in obesity. Surg Clin North Am. 1967;47(6):1345–1351.
[27] Buchwald H. Bariatric surgery for morbid obesity: health implications for patients, health professionals, and third-party payers. J Am Coll Surg. 2005;200(4): 593–604.
[28] Kuzmak LI. A review of seven years' experience with silicone gastric banding. Obes Surg. 1991;1(4): 403–408.
[29] Belachew M, Legrand MJ, Defechereux TH, et al. Laparoscopic adjustable silicone gastric banding in the treatment of morbid obesity. Surg Endosc. 1994; 8(11):1354–1356.
[30] Chua TY, Mendiola RM. Laparoscopic vertical banded gastroplasty: the Milwaukee experience. os. 1995;5(1): 77–80.
[31] Marceau P, Biron S, Bourque RA, et al. Biliopancreatic diversion with a new type of gastrectomy. os. 1993; 3(1):29–35.
[32] Hamoui N, Anthone GJ, Kaufman HS, et al. Sleeve gastrectomy in the high-risk patient. Obes Surg. 2006; 16(11):1445–1449.
[33] Fares MY, Dimassi Z, Baydoun H, et al. Slipping Rib syndrome: solving the mystery of the shooting pain. Am J Med Sci. 2018;357(2):168–173.
[34] Angstadt JD, Bodziner RA. Peripheral polyneuropathy from thiamine deficiency following laparoscopic Roux-en-Y gastric bypass. Obes Surg.. 2005; 15: 890–892.
[35] Dong Q, Jacobson JA, Jamadar DA, et al. Entrapment neuropathies in the upper and lower limbs: anatomy and MRI features. Radiol Res Pract. 2012;2012.
[36] Baima J, Krivickas L. Evaluation and treatment of peroneal neuropathy. Curr Rev Musculoskelet Med. 2008;1(2):147–153.
[37] Shapiro BE, Preston DC. Entrapment and compressive neuropathies. Med Clin North Am. 2009;93(2): 285–315.
[38] Machado FC, Valério BC, Morgulis RN, et al. Acute axonal polyneuropathy with predominant proximal involvement: an uncommon neurological complication of bariatric surgery. Arq Neuro-Psiquiatr.. 2006; 64(3a):609–612.
[39] Hammond N, Wang Y, Dimachkie M, et al. Nutritional neuropathies. Neurol Clin. 2013;31(2):477.
[40] Becker DA, Balcer LJ, Galetta SL. The neurological complications of nutritional deficiency following bariatric surgery. J Obes. 2012;2012:1.
[41] Butterworth RF. Effects of thiamine deficiency on brain metabolism: implications for the pathogenesis of the Wernicke-Korsakoff syndrome. Alcohol Alcohol. 1989;24(4):271–279.