Bariatric Surgery and Its Effects on the Skin and Skin Diseases

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Abstract In light of the increasing prevalence of obesity worldwide, the popularity of bariatric surgery is on the rise. As with any other invasive procedure, these surgeries, especially with the obesity risk factor, carry the risk of direct cutaneous complications following the penetration and manipulation of tissues. In addition, bariatric surgery has an effect on skin structure and function. It also appears to be affiliated with several dermatoses. Some of these represent preexisting diseases the course of which is altered by the procedure, such as psoriasis. On the other hand, other skin disorders are triggered by the surgery itself. This article reviews and summarizes these cutaneous effects and complications.

Keywords Bariatric surgery · Psoriasis · Alopecia · Skin

Introduction

Obesity is a serious global health problem. According to the World Health Organization, it constitutes the fifth leading cause of death alongside overweight leading to over 2.8 million deaths annually. In addition, it is associated with an increased risk of diabetes, ischemic heart disease, musculoskeletal disorders, and even certain cancers [1]. Several approaches to the treatment of clinically significant obesity have been devised. These include dieting, exercise, and drugs among others. Bariatric surgery is considered when nonsurgical treatment fails, with strict eligibility criteria imposed by the National Institutes of Health [2].

Three main categories of bariatric surgery exist. It can be restrictive, malabsorptive, or combined restrictive–malabsorptive. Restrictive procedures such as laparoscopic adjustable gastric banding (LAGB), vertical banded gastroplasty (VBG), and laparoscopic sleeve gastrectomy (LSG) attempt at inducing early satiety by narrowing the gastric lumen. On the other hand, malabsorptive procedures such as jejunooileal bypass (JIB) aim at decreasing the amount of nutrients absorbed via reducing the intestinal surface area exposed to food. Finally, combined procedures include Roux-en-Y gastric bypass (RYGB) and biliopancreatic diversion (BPD), with or without duodenal switch (DS) [3].

There is a wealth of literature available on the complications of bariatric surgery. The commonly reported ones include gastrointestinal leaks, intraabdominal abcesses, gastrocutaneous fistulae, intraabdominal hemorrhage, wound hematomas, infections, dehiscence, deep vein thrombosis, and pulmonary embolism among others [4, 5]. Other complications are procedure-specific. For instance, restrictive procedures can be associated with erosion or slippage of the band and port leakage [6] and stomal stenosis [7, 8]. Other complications may include gastroesophageal reflux disease, esophageal failure, pouch dilation, and gastric prolapse [9].

Obesity is known for its effects on the skin. It is associated with altered collagen structure and content, greater transepidermal water loss, increased skin infections, and poor wound healing. Moreover, most obese patients suffer from acne, hirsutism, and sometimes androgenetic alopecia due to increased androgen production secondary to elevated insulin levels. Furthermore, certain dermatoses such as psoriasis, keratosis pilaris, seborrheic dermatitis, lichen sclerosi s, scleroderma, livedo reticularis, granular parakeratosis, and others have been attributed to obesity [10]. Interestingly, various cutaneous complications have been reported in association with bariatric surgery for morbid obesity as well as a change in the course of many dermatoses. However, to the
best of our knowledge, no article has focused solely on the effects of bariatric surgery on the skin and skin diseases. In this paper, we reviewed the diverse effects of bariatric surgery on the skin including complications directly related to the surgery and indirect effects in triggering (such as nutritional dermatoses) or affecting the course of several dermatoses.

**Direct Cutaneous Complications of Bariatric Surgery**

As any other invasive procedure, bariatric surgery may directly cause several cutaneous complications, the risk of which is increased because of the obesity factor. This is only rational as post-bariatric patients exhibit an elevated risk for cutaneous complications following such procedures compared to non-obese cosmetic surgery patients. According to Michaels et al., post-bariatric patients were at higher risk for the development of infection, wound dehiscence, necrosis, scarring, suture granuloma, lymphedema, and neuropathy [11]. Wound infection [3, 5, 7, 8, 12–15], with subsequent necrosis and scarring, and dehiscence [5, 16], are to name but a few. In addition, the risk of infection varies depending on the procedure or the method performed. For example, in their study on wound infections associated with the linear- versus the circular-stapled anastomoses in laparoscopic RYGB, Shope et al. found an increased incidence of infection with the latter [17]. Another study comparing laparoscopic to open bariatric surgery found a 79% reduction in the risk of wound infection for laparoscopic procedures, which is expected due to the smaller incisions and subsequently their reduced exposure to microorganisms and need for healing time [14]. Another finding in post-bariatric patients is neuropathy. Bussoloro et al. found that post-bariatric patients exhibited impaired cutaneous sensitivity. In addition, these patients seemed to have lost the normal correlation between aging and skin sensation as if they had already reached the sensory thresholds of older age groups [18]. On the other hand, while obesity causes microvascular dysfunction [19–21], normal skin vasomotor and vasodilator function were restored 1 year post-gastric bypass surgery [22]. Post-bariatric body contouring is often needed to complement the weight loss afforded by bariatric surgery. Several cases of severe wound infection have been reported including a patient whose post-bariatric abdominoplasty was complicated by a devastating methicillin-resistant *Staphylococcus aureus* wound infection [23]. Furthermore, in a study on the effect of bariatric surgery on wound healing, all patients had wound healing problems with lengthened duration compared to the standard population. D’ettore and his colleagues attribute this to poor nutrition, compromised vascularization, persistent inflammation, and reduced collagen in post-bariatric patients [24].

**Dermatoses Associated with Bariatric Surgery**

**Bowel-Associated Dermatosis–Arthritis Syndrome**

Bowel-associated dermatosis–arthritis syndrome (BADAS), previously known as bowel bypass syndrome, is often reported in post-bariatric patients [25–30]. It was first described in patients who had undergone JIB which was famous from the 1960s until the 1980s [30]. It has also been observed in patients following RYGB [25, 26] and BPD [27]. However, it has also been diagnosed in patients who had not had any bypass procedure [31, 32]. Patients typically present with polyarthralgias, polyarthritis, myalgias, and a range of dermatoses [25]. In addition, the syndrome may be associated with diarrhea and malabsorption [33]. Skin manifestations include panniculitis, eccymoses, pustular vasculitis, and erythema nodosum [25]. BADAS belongs to a group of similar skin diseases called neutrophilic dermatoses that are characterized by the presence of aseptic neutrophilic infiltrates in the skin [33, 34]. However, an atypical case of BADAS has been reported where histopathology failed to reveal significant dermal neutrophilic infiltrate [26]. The pathophysiology of the disease is believed to begin with bacterial overgrowth in blind intestinal loops and a subsequent immune response. The resulting immune complexes get deposited in the skin causing inflammation [25, 27–29].

**Psoriasis**

Psoriasis is a chronic inflammatory disorder of the skin. Several studies and case reports have described improvement after bariatric surgery [35–40]. In a recent study, almost two thirds of patients with psoriasis reported a post-operative improvement in psoriasis after undergoing weight loss surgery [35]. In addition, this study demonstrated a significant downgrade in psoriasis treatment after surgery. Similarly, another recent study demonstrated complete resolution of psoriasis in 70% of patients 6 months after undergoing bariatric surgery as well as improvement in the quality of life [36]. These morbidly obese patients suffering from a host of comorbidities and accompanying psoriasis exhibited complete remission following weight loss [35–40]. Four of the cases had undergone RYGB [38–40], as opposed to a JIB in the fifth [37]. In addition, Higa-Sansone et al. and de Menezes Ettinger et al. state that neither of their patients had experienced the Koebner phenomenon, which is the development of psoriatic lesions at sites of operative scars in psoriatic patients [39, 40]. On the other hand, another report described the case of a woman who began suffering severe and more frequent flares of psoriasis following a bariatric procedure of unknown nature [41]. Studies have revealed a close relationship between...
psoriasis and obesity [21, 42–47]. In addition, it has been shown that the extent of overweight affects the severity of psoriasis [42]. Obesity is known to induce a chronic state of inflammation in the body by increasing the release of tumor necrosis factor alpha (TNF-α) [38, 46, 48, 49]. TNF-α, the interleukins IL-1, IL-6, IL-17, and interferon-γ are cytokines involved in psoriasis [10]. This may contribute to the development of the disease [46]. Moreover, studies have related psoriasis to elevated leptin levels in patients [38]. Not only does leptin, which is released by fat cells, reduce T-cell autoregulation, but it also contributes to inflammation by stimulating the production of cytokines [10]. Consequently, weight loss induced by bariatric surgery reduces the amounts of inflammatory cytokines and leptin released by adipose tissue [38]. Another assumption is that the comorbidities of obesity may also worsen the disease [39]. Metabolic syndrome is a proinflammatory state; its alleviation following bariatric surgery may contribute to the improvement of psoriasis according to Pérez-Pérez et al. [39]. Similarly, diabetes, hypertension, obstructive sleep apnea, and arthritis pose an organic stress aggravating the lesions. Accordingly, the positive effect of bariatric surgery on these comorbidities may also reflect well on psoriasis according to Higa-Sansone et al. They also claim that the excess fat stretches the patients’ skin, causing physical stress further worsening the lesions [39]. Faurshou et al. suggest that glucagon-like peptide-1, which has been shown to increase up to 20-fold following RYGB, may play a role. It may improve psoriasis through a direct anti-inflammatory role and indirectly by inducing weight loss [50].

Nutritional Deficiency Dermatoses

Morbidly obese patients often suffer from several nutritional deficiencies. These deficiencies are further aggravated following bariatric surgery owing to the restrictive, malabsorptive, or combined nature of the procedure [51, 52]. Slater et al. conducted a study on patients undergoing BPD with or without DS. Their study showed that 69 and 63 % of the 170 patients were deficient in vitamin A and vitamin D, respectively, after 4 years [53]. As a result of such anticipated deficiency, post-bariatric patients are routinely prescribed dietary supplements to compensate for what they may later lack. Despite that, patients frequently present with manifestations of persistent deficiency, whether cutaneous or otherwise. A 32-year-old lady presented with glossitis, angular cheilitis, and an erythematous, desquamative dermatitis and diminished niacin levels 3 months post-RYGB [54]. Similarly, another 51-year-old lady presented with pellagra-like eruption 5 years following VBG [55]. In addition, phrynoderma secondary to vitamin A deficiency is also reported in post-bariatric patients [56–58]. It is characterized by follicular hyperkeratosis, xerosis, and hyperpigmentation mainly on the extensor surfaces [59–61]. Patients also complain of accompanying visual problems [56]. Furthermore, one patient presented with purpura fulminans following Streptococcus pneumonia sepsis. Purpura fulminans is known to ensue following severe infection and deficiency of proteins C and S. In this case, the patient had undergone gastric bypass a year before presentation; the authors relate her susceptibility to purpura fulminans to malabsorption of vitamin K and subsequent deficiency of these vitamin K-dependent proteins [62]. Moreover, Lewandowski et al. reported a woman presenting with an acrodermatitis enteropathica-like eruption 6 months following RYGB. Laboratory tests revealed decreased levels of albumin, hemoglobin, vitamin A, vitamin D, copper, and zinc [63]. Acrodermatitis enteropathica is a rare autosomal recessive disorder characterized by dermatitis mainly involving the perioral and intertrigeneous areas due to zinc deficiency. Patients with acrodermatitis enteropathica-like disease secondary to acquired zinc deficiency show similar findings [64].

Alopecia

Several studies have reported alopecia as a consequence of different kinds of bariatric procedures [65–69]. Hair loss, both mild and severe, has been observed following RYGB [66], LAGB [67], LSG [68], and VBG [69]. Rojas et al. found that women with a significantly higher intake of zinc and iron suffered mild hair loss compared to others with lower intake [65]. Another study was conducted on 130 subjects who had undergone VBG; it showed persistent alopecia in 47 patients despite vitamin and iron supplementation. However, zinc sulfate supplementation reversed their condition within 6 months [69]. Surgery is known to be a possible cause for telogen effluvium, which is characterized by premature passage of anagen follicles to the telogen phase leading to excessive hair loss. Accordingly, hair loss following bariatric surgery could partly be attributed to telogen effluvium. However, its association with nutrient deficiencies and its different patterns of response to certain supplemenations suggest the involvement of other mechanisms [69, 70]. In fact, hair and nutrition are closely related. Protein malnutrition causes brittleness and dryness of the hair. In addition, zinc deficiency often manifests as progressive, diffuse, patchy, non-scarring alopecia. Likewise, essential fatty acid deficiency exhibits similar clinical findings. Moreover, selenium and biotin deficiencies are reported to cause pseudo-albinism and alopecia and dermatitis and alopecia, respectively. Furthermore, iron is present in several enzymes, cytochromes, and transcription factors and is required for cell processes such as DNA synthesis. As such, the rapidly dividing hair follicle matrix cells may be adversely affected by low iron levels [70].
Effect on the Skin and the Extracellular Matrix

Obesity inflicts a host of physical and metabolic changes upon the skin that affect the matrix composition, epidermal barrier, lymphatic flow, and gland function among others [20, 71]. In addition, certain dermatoses such as acanthosis nigrians and striae distensae are commonly observed in obese patients [72]. Similarly, post-bariatric patients suffer from several skin abnormalities. Extensive weight loss following surgery leads to surplus skin that is reported to cause patient discomfort and several problems [73, 74]. A study conducted on 148 individuals who had undergone laparoscopic gastric bypass showed that fungal infections, eczema, pruritis, excessive perspiration, and hygiene issues were common occurrences following surgery due to the excess skin and tissue after weight loss [73]. In addition, another study by Light et al. detected abnormalities in post-bariatric patients’ skin and its extracellular matrix. The authors describe the extracellular matrix in their patients as loose compared to normal skin tissue. Tissue recovered from both normal-appearing skin and from striae exhibited inflammation, scarring, collagen resorption, and elastin degradation. They also noted nonhomogeneity of tissue composition with shortened, degraded collagen strands with more cross-link formation [71]. On the other hand, Orphee et al. reported in their study on 40 post-bariatric patients compared to 40 never-obese controls that collagen appeared to be depleted while elastic fibers were not [74].

Vasculitis and Other Dermatoses

Several cases of vasculitis have been reported following bariatric surgery. Danese et al. described the case of a lady presenting with Henoch–Schönlein purpura (HSP) 5 years after BPD [75]. HSP is a small vessel vasculitis characterized by the tetrad of arthritis, nonthrombocytopenic purpura, abdominal pain, and renal disease [76]. Another patient developed cryoglobulinemia, polyarthritis, purpuric skin rash, and acute renal failure 4 years after JIB [77]. Similarly, Goldman et al. report two cases of necrotizing vasculitis with tenosynovitis arthralgia/arthritis syndrome also following JIB [78]. In all four cases, the assumption is that intestinal bacterial overgrowth triggers an immune response leading to the deposition of immune complexes in the affected organs including the skin [75, 77, 78].

Another patient presented with tender, erythematous nodules on her legs and abdomen typical of nodular nonsuppurative panniculitis having undergone jejunoileal bypass. Williams et al. state that the patient did not appear to have any known predisposing conditions [79]. Last but not least, Kovaleski et al. describe the development of dermatitis herpetiformis a year and a half after gastric stapling for morbid obesity. This condition manifests secondary to a gluten-sensitive enteropathy, much like celiac disease which is reported to be precipitated by gastric surgery according to the authors [80].

Angiosarcoma

Cutaneous angiosarcomas are rare tumors that carry a very bad prognosis [81, 82]. Stewart–Treves syndrome is defined as the development of angiosarcoma secondary to chronic lymphedema. This has been classically observed in patients after surgery for breast tumors [82, 83]. As obesity and surgery are both associated with lymphedema, obese and post-bariatric patients may be prone to the development of subsequent angiosarcoma. In fact, Robinson et al. reported a case of a gastric bypass patient presenting with metastatic angiosarcoma 4 years after her surgery. A biopsy sample recovered from the lesion revealed findings typical of epithelioid angiosarcoma [81].

Conclusion

In summary, bariatric surgery has diverse effects on the skin. As with any other invasive procedure, these surgeries may cause direct cutaneous complications such as wound infection, wound dehiscence, delayed wound healing, and neuropathy, the risk of which is especially increased with the factor of obesity itself. While bariatric surgery may have a positive effect on psoriasis, several other skin disorders may occur after bariatric surgery such as BADAS, alopecia, or nutritional deficiency dermatoses, the latter emphasizing the importance of following up on nutritional deficiencies in post-bariatric patients.

Conflict of interest All authors (Ali Halawi, Firass Abiad, and Ossama Abbas) declare no conflict of interest.

References


