Effects of Bariatric Surgery on Women during Pregnancy

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It has been shown that women with obesity planning pregnancy should reduce their body weight because obesity is a risk factor for adverse obstetric and neonatal outcomes. Bariatric surgery effectively reduces excessive body weight and the health risks in women with obesity during pregnancy and their offspring. However, at least a year interval between surgery and conception is recommended. An interdisciplinary medical team should provide patient care during pregnancy with knowledge and skills related to people after bariatric surgery. Due to the increased risk of mental disorders, especially depression, it is necessary to constantly monitor the mental state of women and provide psychological support and education on a healthy lifestyle during pregnancy and the postpartum period.

bariatric surgery pregnancy obstetric outcome women obesity

1. Introduction

Obesity is a complex chronic disease in which abnormal or excessive adipose tissue accumulation worsens health, increases the risk of long-term medical complications, and shortens life expectancy. The most common health consequences of obesity are type 2 diabetes, hypercholesterolemia, cardiovascular diseases, cancer, asthma, sleep apnea, osteoarthritis, low quality of life, and depression. Obesity in adults is often classified based on a BMI (weight (kg)/height $(m)^2$) equal to or greater than 30. Other helpful measures include waist circumference, waist-to-hip ratio, midsection arm, bioelectrical impedance measurements of body fat percentage and mass, and direct imaging methods like computed tomography or magnetic resonance imaging (alternatively ultrasonography) of subcutaneous and visceral fat thickness. In addition, when diagnosing obesity, it is worth considering other criteria, such as psychological, social, and economic [1].

The prevalence of obesity in developed countries is steadily increasing. In the United States, 41.9% of adults and 39.6% of women aged 20–39 suffer from this disease. Among women in this group, 12.4% are severely obese (BMI ≥ 40 kg/m^2) [2]. The problem also affects women during pregnancy. European data indicate that 7–35% of mothers have a BMI > 30 at the beginning of pregnancy, and the differences in results are primarily related to social and educational inequalities [3]. Not only obesity before pregnancy but also excessive weight gain during pregnancy is detrimental to the mother's and child's health. It can be caused by many factors: genetic, sociodemographic, environmental, socio-economic, psychological, and medical [4][5]. Despite the recognized benefits of a healthy diet and physical activity during pregnancy, a low percentage of women adhere to prenatal nutritional and physical activity guidelines [6][7]. This situation contributes to postpartum weight retention, which strongly predicts obesity later in life [8].

Due to the increasing risk of obesity and its complications in women of reproductive age and their children, it is necessary to seek therapeutic interventions to ensure the excellent effectiveness of obesity treatment. Although the basis is a healthy lifestyle change, bariatric surgery plays an important role, especially in the case of morbid obesity. Its advantage is a significant loss of body weight in a relatively short time, which allows one to achieve positive health effects related to the quality of life [9]. Regardless of the method of treating obesity, it is worth bearing in mind that both during pregnancy and in other periods of life, the psychosocial context is also crucial for human health. Psychological factors underlying the development, course, and treatment of somatic diseases allow us to understand their nature better and increase effectiveness in clinical practice through comprehensive interaction.

2. The Influence of Bariatric Surgery on Pregnancy and Neonatal Outcomes

In women of reproductive age, contraception is an essential postbariatric recommendation. The intrauterine device is recommended as first-line therapy because the effectiveness of oral contraceptive pills may be reduced due to malabsorption [10][11]. The results of scientific studies confirm the lack of differences in weight loss in the first year after surgery between women using different methods of contraception. At the same time, they indicate that despite the recommendation to avoid pregnancy in the first period after surgery, as many as one third of patients do not use any form of contraception [12].

The recommendation to use contraception in the postoperative period is associated with a potential risk to the child and the pregnant woman herself. In clinical practice, a cautious waiting period of at least two years after bariatric surgery to become pregnant is often suggested. This is because the typical duration of the initial period of significant and rapid weight loss and increased potential risk of nutritional deficiencies is approximately 12–24 months [13]. The guidelines recommend multivitamin and mineral supplementations before conception and throughout pregnancy. In particular, a biochemical assessment is strongly recommended to determine specific micronutrient requirements. The supplement should contain at least copper (2 mg), zinc (8–15 mg per 1 mg copper), calcium (1200–1500 mg in divided doses), selenium (50 µg), folic acid (0.4–1 mg, 4–5 mg if obesity or diabetes), iron (45–60 mg or >18 mg after AGB, thiamine (>12 mg), vitamin D (>40 mcg), vitamin E (15 mg), vitamin K (90–120 µg), and beta-carotene (vitamin A, 5000 IU) [10][14].

According to the latest recommendations regarding pregnancy after bariatric surgery [10], patients should receive nutritional advice. In addition to standard postsurgical dietary advice, it is essential to individualize energy needs (based on pre-pregnancy BMI, gestational weight gain, and level of physical activity), consume protein at least 60 g/day, and limit rapidly absorbed carbohydrates. Nutrition should be systematically monitored before, during, and after pregnancy by checking specific serum indices every three months. Patients should be systematically screened for diabetes and have their body mass controlled.

Available studies evaluating the impact of the time from bariatric surgery to conception on obstetric outcomes assume similar time values for early pregnancy (≤12 months). They mostly agree that it is unfavorable for the pregnant woman and her offspring. Significant weight loss may result in nutrient deficiencies (including vitamin B12 and folic acid) and anemia [15], lower gestational weight gain, lower gestational age at delivery, lower birth weight, and preterm birth [16]. There was no relationship between gestational weight gain and the type of bariatric surgery [17].

However, some scientific reports do not support a correlation between the time from surgery to conception and early or late fetal growth in pregnancies conceived after gastric bypass surgery [18], as well as maternal outcomes (including pregnancy-induced hypertension and gestational diabetes) and neonatal outcomes independently on the type of operation [17]. Even studies report that pregnancies 18 months after gastric bypass, compared with pregnancies in the earlier period, are associated with a higher risk of cesarean section or intravenous iron supplementation [19]. There are also conflicting reports regarding the relationship between weight gain in pregnancies conceived at different times after bariatric surgery and low birth weight [17][19]. The latest recommendations do not specify the time after MBS to conception but indicate the moment of achieving stable body weight [10].

Systematic reviews of studies and meta-analyses on the impact of bariatric surgery on women's health during pregnancy often do not differentiate the type of procedure performed. Conclusions from such studies and studies performed with the mixed method (Roux-Y-gastric bypass (RYGB)) are presented below. Possible health consequences of bariatric surgery for a pregnant woman include:

- Deficiencies of vitamins and microelements, especially iron, vitamin B12, A, phylloquinone, and folic acid [20][21][22], as well as zinc, selenium, and vitamins A1, B1, B6, and C [23];
- Hormonal changes—an increase in the level of sex hormone binding globulins (SHBG), progesterone, and estradiol and a decrease in the level of androgens, androstenedione, and testosterone; LH and FSH remained unchanged; studies on anti-Mullerian hormone (AMH) are inconsistent [22][24];
- Improvement in the regularity of menstrual cycles and fertility [22];
- Lower risk of gestational diabetes [9][21][25][26][27] but a higher risk of hypoglycemia and hyperglycemia [28];
- Lower risk of gestational hypertension [9][21][25][26][27][29];
- Higher risk of anemia [9][21];
- Higher risk of fractures [9];
- No effect on gestational weight gain [30].

Some scientific reports differentiate the effects of bariatric surgery depending on its type. On this basis, it is known that restrictive methods contribute to the increase in the level of folic acid, do not cause changes in the level of vitamin B12 and D,

have no effect or increase the level of antimullerian hormone (AMH), do not affect the level of FSH and estradiol, have a positive effect on the regularity of menstrual cycles and fertility [22], and reduce the risk of pre-eclampsia [31]. In turn, methods that impair absorption cause an increase in the level of folic acid but a decrease in the level of vitamin B12, a decrease in the level of luteinizing hormone (LH) and estradiol, an increase in the level of follicle-stimulating hormone (FSH) and sex hormone binding globulin (SHBG), and an increase or decrease in testosterone and dehydroepiandrosterone sulfate; they do not change the level of androstenedione. The results of studies on the effect of the regularity of the menstrual cycle are inconsistent [22].

Although the vast majority of studies on the effects of bariatric surgery in women during pregnancy are based on the comparison of postoperative women with control groups with matched BMI (most often women with obesity), some reports refer to the general population [32] or women with a normal BMI [31]. Compared with these two groups, women during pregnancy who have undergone bariatric surgery are still more likely to have hypertension and gestational diabetes. At the same time, they may show changes in physiological patterns in the lipid profile, which make them comparable to women of normal weight (C-reactive protein) or lower weight (TC, LDL-C, and non-HDL-C) [33]. Hypoglycemia and large and rapid spikes in blood glucose levels are under-reported in women during pregnancy after bariatric surgery, and diagnosing gestational diabetes mellitus is more complicated. It is often based on the oral glucose tolerance test (OGTT), although it is considered unreliable in bariatric patients [34].

Regardless of the type of bariatric surgery, reports concerning women's mental state during pregnancy are worrying. An increase in the incidence of mental disorders is reported, especially depression [35][36][37] and anxiety [36], as well as an increase in the incidence of self-harm and suicide [9], and a significant proportion of women who consume alcohol (33.5%) and use opioids (28.5%) have also been observed [37]. A significant relationship with depressive symptoms may include marital status, whether the pregnancy was planned and desired, and a history of mental disorders. In turn, mental disorders during pregnancy may increase the rates of abortion, hemorrhage, low birth weight, and negative consequences for the child's psychosocial development. In addition, the psychiatric background may result in less adherence to prenatal care and difficulties in the woman's acquisition of self-care habits, and it affects the quality of the mother–child relationship during pregnancy and postpartum, mainly due to its association with postpartum depression [35]. Considering the above facts, screening patients' mental condition after MBS is recommended before, during, and after pregnancy. Monitoring for substance abuse, depression, and anxiety seems particularly important [10].

In addition to mental disorders, women after bariatric surgery experience many fears that negatively affect their mental well-being. Some of them coincide with typical concerns of pregnant women (e.g., whether the child will be born healthy). However, others are specific to this group of patients and concerned with the issues of proper nutrition and growth of the child, gastrointestinal problems (pain associated with dumping or bowel obstruction), weight gain and return to pre-surgery weight, and social judgment about eating too small portions and the negative impact of this on the baby. These concerns are independent of whether bariatric surgery was the goal for a consciously planned pregnancy or whether the pregnancy was unplanned or complicated [38]. There is also the issue of weight-related shame, self-blame, and fear of stigmatizing bariatric treatment in scientific reports. These factors affect women's expectations regarding health care during pregnancy, follow-up visits, and the availability of information and may also be a barrier to seeking or accepting professional help. Lack of proper care and medical education during pregnancy negatively affects risk awareness, misconceptions about the impact of breastfeeding on weight loss, and the belief that weight gain during pregnancy is not a response to lifestyle changes. It reduces the motivation and tendency of women to lead a healthy lifestyle [39].

The bariatric surgery of a woman before pregnancy affects the course of pregnancy and obstetric outcome. Therefore, fetal ultrasound examinations should be performed routinely during pregnancy after MBS in the first two trimesters (12 and 20 weeks) and once monthly in the third trimester [10]. Scientific reports indicate the following effects of surgery, regardless of the type of surgery performed and in mixed procedures (RYGB):

- Frequency of spontaneous abortion—inconsistent research results; some report no effect, while others report an increase in the frequency of miscarriages [22];
- Fetal defects—research results are inconsistent [40]; some reports indicate no effect [22][41] or reduced risk [22][29]. However, some studies report an increased risk [9];
- Preterm birth—results are mostly inconsistent [29], although a few reports report an increased risk [9][42][43];
- Post-term delivery—lower risk [44][45];

- Cesarean delivery—the results of reports are inconsistent [29]; some studies indicate a decrease in the risk of unplanned cesarean delivery [45];
- Obstetric anal sphincter injury, postpartum hemorrhage—lower risk [45];
- Transfer of a newborn to the intensive care unit (ICU)—higher risk [9];
- Perinatal death—no effect [43] or increased [9][44];
- Small for gestational age—higher risk [9][21][25][26][27][29][42][43];
- Low birth weight—increased risk [30][44];
- Adipose tissue—lower lean mass and percentage of fat [46];
- Large for gestational age—a decrease in risk [9][27][43];
- Fetal macrosomia—risk reduction [9][21][26][29];
- Fetal consequences of vitamin deficiency—visual complications (vitamin A), intracranial hemorrhage (phylloquinone), neurological and developmental disabilities (vitamin B-12), and malformations (folic acid) [20].

The above studies compared women with obesity after bariatric surgery and women with obesity without surgical treatment, and studies concerned single pregnancies. However, few studies on twin pregnancies have also confirmed the association of bariatric surgery before pregnancy with delayed intrauterine growth of the fetus, as indicated by fetal parameters such as slower growth of subcutaneous fat tissue and abdominal circumference, as well as lower birth weight of the newborn [47].

Compared with the general population, women after bariatric surgery are at a higher risk of preterm delivery, labor induction, planned and unplanned cesarean sections, having a child small for gestational age, and having low birth weight [32]. Regarding the impact of MBS on pregnancies resulting from in vitro fertilization (IVF), it has been shown that women from this group, compared with women with the same BMI but not surgically treated, produce fewer oocytes and have fewer frozen embryos, and their children have a much lower birth weight. However, there was no association between MBS and a reduction in the cumulative live birth rate [48].

Compared with the population of women with normal weight, pregnant women after bariatric surgery are more likely to have acute abdominal pain during pregnancy; low birth weight; neonatal admission to the intensive care unit [31]; reduced (<2.5 percentile) concentration of calcium; and elevated (97.5th percentile) of magnesium, vitamin E, 25-hydroxyvitamin D, and vitamin B12 [49]. The woman's body weight immediately before conception seems essential for the discussed results. Despite bariatric surgery, most women become pregnant with a BMI > 30, which may negatively impact obstetric outcomes [50]. On the other hand, in a 2023 systematic review of studies, no clear and consistent associations were identified between dietary intake, supplementation, or GWG and micronutrient deficiency [51]. Nutritional deficiencies can occur in a pregnant woman, regardless of her body weight or whether she has previously undergone bariatric surgery. In every case, nutritional deficiencies negatively influence fetal development, neonatal complications, and long-term outcomes [20][52][53]:

- Vitamin B12—fetal malformations, anemia, neutropenia, delayed gross motor, and delayed speech;
- Vitamin B9—birth neural tube defect, spinal cord or brain defect, and subsequent development of encephalocele; hydranencephaly; anencephaly; spina bifida, including meningocele and myelomeningocele;
- Vitamin A—congenital abnormalities, premature birth, ventricular dilatation, retardation, bilateral microphthalmia, ocular malformations, and retinal damage;
- Vitamin D—skeletal defects, inferior adherent leucoma, and light-sensitive child;
- Vitamin K deficiency—optic nerve hypoplasia and musculoskeletal defects;
- Folic acid—neural tube defects and ventricular septal defects;
- Iron (Fe), calcium (Ca), and zinc (Zn)—preterm birth, epilepsy, severe anemia, blindness, and deafness.

The mental state affects the course of pregnancy, childbirth, and the postpartum period. In addition to the patient's individual conditions, the relationship with the medical staff plays a significant role. In the case of women during pregnancy and those giving birth after bariatric surgery, in addition to typical relational needs (sense of security and support), the knowledge of medical staff related to bariatric surgery and the willingness to talk about it play an essential role [38]. Midwives' empathy and awareness of the social stigma of obesity may paradoxically prevent them from discussing body weight for fear of embarrassing or worrying the patient [39]. This indicates the need for professional psychological education of medical staff in the area of interpersonal communication in general, with particular emphasis on the issues of obesity and bariatric surgery.

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