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Review Article

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The Korean Society for Metabolic and Bariatric Surgery (KSMBS) Position Statement on Female Candidates of Reproductive Age for Metabolic Bariatric Surgery

Yoona Chung [1], In Cho [2], Yun Suk Choi [3], Yoo Min Kim [4], Yoontaek Lee [5], Shin-Hoo Park [6], Mi Ran Jung [7], In Gyu Kwon [8], Jongmin Kim [9], Sang Eok Lee [10], Jihun Kim [11], Seong-Ho Kong [12], Kyung Won Seo [13], Sung Il Choi [14], Jong-Han Kim [15], Tae Kyung Ha [16], Jin-Jo Kim [17], Young Suk Park [18], Moon-won Yoo [19], Dong Jin Kim [20], Ji Yeon Park [21], Han Mo Yoo [22], Hyuk-Joon Lee [13], Sang Hyun Kim [23], Han Hong Lee [24], Do Joong Park [12], Sungsoo Park [15], Sang-Moon Han [25], Yong Jin Kim [1], Joong-Min Park [26], Seung-Wan Ryu [27], Sang Kuon Lee [22], Jee Yoon Park [28], Jong Won Kim [29] on behalf of the Guidelines Committee of the Korean Society for Metabolic and Bariatric Surgery

[1]Metabolic and Bariatric Surgery Center, Department of Surgery, H+ Yangji Hospital, Seoul, Korea
[2]Department of Surgery, Soonchunhyang University Bucheon Hospital, Bucheon, Korea
[3]Department of Surgery, Inha University Hospital, Incheon, Korea
[4]Department of Surgery, Severance Hospital, Yonsei University College of Medicine, Seoul, Korea
[5]Department of Surgery, Ewha Womans University Seoul Hospital, Ewha Womans University College of Medicine, Seoul, Korea
[6]Division of Gastrointestinal Surgery, Department of Surgery, Uijeongbu Eulji Medical Center, Eulji University College of Medicine, Uijeongbu, Korea
[7]Department of Surgery, Chonnam National University Medical School, Hwasun, Korea
[8]Department of Surgery, Gangnam Severance Hospital, Yonsei University College of Medicine, Seoul, Korea
[9]Min Hospital, Seoul, Korea
[10]Department of Surgery, Konyang University Hospital, Daejeon, Korea
[11]Wellness Hospital, Busan, Korea
[12]Department of Surgery, Seoul National University Hospital, Seoul, Korea
[13]Department of Surgery, Kosin University Gospel Hospital, Busan, Korea
[14]Department of Surgery, Kyung Hee University Hospital at Gangdong, Seoul, Korea
[15]Department of Surgery, Korea University College of Medicine, Seoul, Korea
[16]Department of Surgery, Hanyang University College of Medicine, Seoul, Korea
[17]Department of Surgery, Incheon St. Mary's Hospital, The Catholic University of Korea, Incheon, Korea
[18]Department of Surgery, Seoul National University Bundang Hospital, Seoul National University, College of Medicine, Seongnam, Korea
[19]Department of Surgery, Asan Medical Center, University of Ulsan, Seoul, Korea
[20]Department of Surgery, Eunpyeong St. Mary's Hospital, The Catholic University of Korea, Seoul, Korea
[21]Department of Surgery, Kyungpook National University Chilgok Hospital, Daegu, Korea
[22]Department of Surgery, College of Medicine, The Catholic University of Korea, Seoul, Korea
[23]Department of Surgery, Soonchunhyang University Seoul Hospital, Soonchunhyang University School of Medicine, Seoul, Korea
[24]Division of Gastrointestinal Surgery, Department of Surgery, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea
[25]Department of Surgery, Seoul Medical Center, Seoul, Korea
[26]Department of Surgery, Chung-Ang University Gwangmyeong Hospital, Gwangmyeong, Korea
[27]Keimyung University Dongsan Medical Center, Daegu, Korea
[28]Department of Obstetrics and Gynecology, Seoul National University Bundang Hospital, Seoul National University, College of Medicine, Seongnam, Korea
[29]Department of Surgery, Chung-Ang University Hospital, Chung-Ang University College of Medicine, Seoul, Korea

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Corresponding author:
Jong Won Kim
Department of Surgery, Chung-Ang University Hospital, Chung-Ang University College of Medicine, 102 Heukseok-ro, Dongjak-gu, Seoul 06973, Korea.
Tel: +82-2-6299-1571
Email: drholy@gmail.com

ORCID iDs
Yoona Chung
https://orcid.org/0000-0002-2812-8714
In Cho
https://orcid.org/0000-0002-8568-0679
Yun Suk Choi
https://orcid.org/0000-0003-2442-664X
Yoo Min Kim
https://orcid.org/0000-0002-5176-804X
Yoontaek Lee
https://orcid.org/0000-0003-2643-2007
Shin-Hoo Park
https://orcid.org/0000-0001-9767-6100
Mi Ran Jung
https://orcid.org/0000-0002-4665-972X
In Gyu Kwon
https://orcid.org/0000-0002-1489-467X

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Seong-Ho Kong
https://orcid.org/0000-0002-3089-0572
Kyung Won Seo
https://orcid.org/0000-0002-5771-3832
Sung Il Choi
https://orcid.org/0000-0002-0662-0951
Jong-Han Kim
https://orcid.org/0000-0001-8955-3944
Tae Kyung Ha
https://orcid.org/0000-0001-7320-5507
Jin-Jo Kim
https://orcid.org/0000-0003-1011-8793
Young Suk Park
https://orcid.org/0000-0002-6352-9759
Moon-won Yoo
https://orcid.org/0000-0003-0346-9042
Dong Jin Kim
https://orcid.org/0000-0003-4699-4058
Ji Yeon Park
https://orcid.org/0000-0002-6178-7906
Han Mo Yoo
https://orcid.org/0000-0002-6332-9693
Hyuk-Joon Lee
https://orcid.org/0000-0002-9530-647X
Sang Hyun Kim
https://orcid.org/0000-0002-0345-7044
Han Hong Lee
https://orcid.org/0000-0002-7541-8490
Do Joong Park
https://orcid.org/0000-0001-9644-6127
Sungsoo Park
https://orcid.org/0000-0002-1779-8683
Sang-Moon Han
https://orcid.org/0000-0001-8631-0998
Yong Jin Kim
https://orcid.org/0000-0003-1222-2121
Joong-Min Park
https://orcid.org/0000-0002-8582-6391
Seung-Wan Ryu
https://orcid.org/0000-0001-6429-5926
Sang Kuon Lee
https://orcid.org/0000-0002-3720-2461
Jee Yoon Park
https://orcid.org/0000-0002-2047-5703
Jong Won Kim
https://orcid.org/0000-0003-3595-5336

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ABSTRACT

Obesity has emerged as a major global health issue. The ratio of male to female patients undergoing metabolic bariatric surgery (MBS) is 1:3.5. Although not as dramatic compared to the global trend, the rate of obesity in women of reproductive age in Korea has been steadily increasing over the past several decades. The impact of obesity on reproductive health and perinatal outcomes should be carefully considered when consulting female candidates of reproductive age for MBS. Obesity adversely affects reproductive health by causing menstrual irregularities, anovulation, subfertility, and increased miscarriage risk, as well as impairing the success of assisted reproductive technologies. Maternal obesity also heightens the risk of adverse perinatal outcomes, including childhood obesity and metabolic disorders. MBS has been shown to improve fertility outcomes and reduce obesity-related pregnancy complications, although concerns remain regarding potential risks such as small-for-gestational-age infants due to rapid weight loss and nutritional deficiencies. Despite these implications, current MBS guidelines rarely address the unique needs of reproductive-age women. In response, the Korean Society for Metabolic and Bariatric Surgery convened a task force to develop evidence-based recommendations tailored to this population. This position statement aims to guide the management of obesity in women of reproductive age to optimize reproductive and perinatal outcomes.

Keywords: Obesity; Morbid; Bariatric surgery; Reproductive health; Pregnancy outcome; Infertility; Female

INTRODUCTION

Obesity has emerged as a major global health issue. According to recent statistics, the prevalence of obesity (body mass index [BMI] ≥25.0 kg/m^2) in Korean adults is 31.8% with a prevalence of 32.4% in men and 29.4% in women [1]. The ratio of male to female patients undergoing metabolic bariatric surgery (MBS) is 1:3.5, meaning that for every male patient, there are 3.5 female patients undergoing MBS [2]. There is an evident gender disparity of more women undergoing MBS compared to men exists despite the higher prevalence of obesity in Korean men. Although not as dramatic compared to the global trend, the rate of obesity in women of reproductive age in Korea has been steadily increasing over the past several decades [3-5]. Given these factors, the impact of obesity on reproductive health and perinatal outcomes should be carefully considered when consulting female candidates of reproductive age for MBS [6].

The effect of obesity on reproductive health is significant leading to irregular menses, anovulation, subfertility, and higher miscarriage rates. Obesity also impairs the success of assisted reproductive technologies. Maternal obesity raises the risk of adverse outcomes for offspring, such as childhood obesity and metabolic disorders. Therefore, managing obesity before and during pregnancy is crucial for the health of both mother and child [7,8]. MBS has been known to reverse obesity-related infertility, improve ovulation and menstrual regularity, and enhance fertility by addressing underlying hormonal issues. While MBS before pregnancy has been shown to reduce the risks of gestational diabetes and preeclampsia, there have been concerns of the potentially increased risk of small-for-gestational-age babies in relation to rapid weight loss and nutritional deficiencies.

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The majority of current guidelines on obesity and MBS do not specifically address women of reproductive age. This oversight represents a missed opportunity to meet the unique needs of this significant population, underscoring the imminent need for clear, evidence-based guidelines [9]. These guidelines should consider the unique physiological and hormonal changes women experience during the stages of preconception, pregnancy, and postpartum so that healthcare providers can offer targeted and effective approaches to the treatment of obesity in female candidates of reproductive age. A task force team composed of experienced metabolic and bariatric surgeons was designated by the Korean Society for Metabolic and Bariatric Surgery (KSMBS). A comprehensive literature review was conducted to draft updated and clear statements on these relevant issues. The statements and references were reviewed by the board members as well as by an independent expert in obstetrics. This position statement by the KSMBS aims to provide such guidelines for treating obesity in women of reproductive age to ensure optimal reproductive outcomes.

PROCEDURE SELECTION OF MBS IN WOMEN OF REPRODUCTIVE AGE

Recommendation:

A. Procedure selection should be done based on the patient's current BMI, comorbidities, and patient preference. Patients who plan on a future pregnancy should understand the possible surgical complications related to malabsorptive procedures and adjustable gastric banding (AGB).

The application of MBS for the treatment of obesity has been increasing steadily. There is abundant evidence on the benefits of MBS for metabolic syndrome and lasting substantial weight loss [10-13]. The indication for MBS is expanding and patients of various ages and conditions are choosing surgical intervention. Restrictive procedures include AGB and sleeve gastrectomy (SG). Malabsorptive procedures include Roux-en-Y gastric bypass (RYGB), one-anastomosis gastric bypass, and SG plus various bypasses (duodenojejunal bypass, proximal jejunal bypass, etc.). The practice of AGB has been on a rapid decline due to its high complication rate with an increase in application of SG due to its safety profile and relative technical ease with its comparable effects on weight loss and metabolic effects with that of RYGB. Long-term data on the differences in weight loss and remission of obesity-related comorbidities among these procedures are being updated with further research.

It is well known that up to 80% of the patients receiving MBS are women of reproductive age [14]. Many of these women desire to conceive within 2 years of MBS [15]. Procedure selection in this population is yet to be discussed. Personal medical history, degree of obesity, comorbidities, eating behavior and preference of the patient and surgeon should all be taken into account. Sufficient discussion with clinical evidence must be done when deciding on the procedure. Education of increased fertility and methods of contraception should also be reviewed when considering MBS in women of reproductive age.

Women considering MBS should be informed of the risks of surgical complications (migration, slippage or erosion) related to AGB alone or performed concomitantly with an additional procedure. When considering MBS with a malabsorptive component that includes

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the alteration of the anatomy of the small intestine,) the higher frequency of small for gestational age (SGA) and nutritional deficiencies must be noted [16,17]. The relatively minor differences of weight loss outcomes should be weighed with the risk of protein malnutrition, micronutrient deficiencies and diarrhea of malabsorptive procedures [18]. However, Chao et al. [15] reported that there were no significant differences in adverse obstetric outcomes and risk of re-interventions including revision, enteral access, reoperation and vascular access within 2 years of MBS between patients who have received SG or RYGB. Eventually, the most important factor in the choice of surgical procedure is the joint decision of the patient and the doctor.

FERTILITY AFTER MBS

Recommendations:

A. Education of increased fertility and the appropriate method of contraception should be carried out for all patients of reproductive age before MBS.
B. Oral contraceptives increase perioperative thrombotic risk and should be discontinued 4 to 6 weeks before and 6 weeks after MBS. Parenteral long-acting reversible contraception (LARC) methods are effective and easily applicable first line methods for contraception after MBS.
C. Pregnancy is recommended after a minimum of 12 months after MBS until body weight loss is stabilized.

1. Effects to fertility and importance of preoperative education before MBS

Polycystic ovarian syndrome (PCOS) in female patients with severe obesity induces anovulation. Weight loss after MBS results in improvement in PCOS due to metabolic and hormonal changes leading to recovery of ovulation [19-22]. Skubleny et al reported a systematic review of the effects of MBS on PCOS. In a total of 2,130 patients in 13 studies, PCOS rates decreased from 45.6% to 6.8% and infertility decreased from 18.2% to 4.3% after 12 months of MBS [23]. In addition, it is well known that the infertility rate is high in female patients with severe obesity even if they do not have PCOS. However, it has been reported that improvements in the menstrual cycle and hormonal profile appear immediately after MBS [24]. A sudden increase in the level of sex hormone binding globulin, reduction in androgens level and increase in follicular stimulating hormone are seen after surgery. These changes help infertile women become pregnant naturally. Therefore, education of increased fertility and the appropriate method of contraception should be carried out for all patients of reproductive age before MBS in order to avoid unwanted pregnancies.

2. Contraception methods recommended before and after MBS

Venous thromboembolism and arterial thrombosis are known to increase with oral contraceptives. Therefore, oral contraceptives should be stopped at least 4–6 weeks before MBS and started 6 weeks after MBS. During this period, parenteral LARC methods, such as copper intrauterine devices, intrauterine systems, and progestogen implants, can be considered.

The effectiveness of oral contraceptives is known to decrease after MBS [25], depending on changes in bowel absorption function associated with different surgical methods. Hormonal contraception is usually absorbed in the upper gastrointestinal tract, which is significantly

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affected by various MBS methods. In AGB and SG, oral contraceptives can be used theoretically if there is no vomiting or diarrhea [26]. In RYGB, the use of oral contraceptives is considered with a low level of evidence [26,27]. The use of oral contraceptives is contraindicated in operations such as biliopancreatic diversion with duodenal switch (BPD/DS) and single-anastomosis duodeno-ileal bypass [16].

The optimal method of contraception after MBS is still debated in terms of patient preference, cost and effectiveness. Parenteral LARC methods are effective and easily applicable first line methods [19,27,28].

3. Appropriate interval from MBS to conception

Maternal nutritional deficiency occurs when weight loss is maximal which is most commonly from postoperative month 12 to 18. In a study of 77 mothers who underwent RYGB and 46 mothers who underwent SG, weight loss after MBS was more significant in RYGB mothers (45.6±12.4 vs. 39.5±13.7 kg, P=0.02). The rate for small neonates for gestational age was significantly higher in RYGB mothers (24% vs. 19%, P=0.04). The authors concluded that the degree of maternal weight loss, rather than postoperative metabolic changes, was the most important cause of abnormalities during pregnancy after MBS [29]. Additionally, a higher incidence of stillbirths has been reported in women conceived within 1 year of MBS and more obstetric complications have been reported with a higher maternal BMI after MBS [30,31]. Therefore, an observation period for weight stabilization after MBS is needed. Pregnancy is recommended after a minimum of 12 months after MBS but can be considered earlier in patients with advanced maternal age or reduced ovarian reserve [16].

1) Obstetric concerns according to the timing of conception after MBS

The risk of gestational diabetes mellitus (GDM) and large for gestational age is reduced in mothers who have undergone MBS. Also, preeclampsia, hypertension, macrosomia, and congenital malformations are known to decrease after MBS [32,33]. In contrast, the incidence of lower birth weights, shorter gestation, and SGA is known to increase [34].

Some reports have reported differences in obstetric problems according to surgical methods. BPD/DS has been reported to have a higher incidence in SGA infants compared to RYGB [30]. Another study reported that fetal growth restriction occurred more frequently in mothers who underwent RYGB compared to AGB and SG [35]. Other reports reported that there was no difference in obstetric complication, gestational age at delivery, or birth weight between mothers who underwent AGB and RYGB [36].

Several studies have reported obstetric problems with timing of pregnancy after MBS surgery. Parent et al. [30] reported an increased probability of SGA infants and prematurity, along with a higher likelihood of neonatal intensive care unit hospitalization, when childbirth occurred within 2 years post-MBS. Gurewitsch et al. [37] reported that there was no difference in the incidence of SGA when comparing before and after 18 months of MBS. Several other reports also failed to find a significant difference in gestational outcomes according to conception interval after MBS [14,38-41].

2) Neonatal concerns according to the timing of conception after MBS

Macrosomia is defined as fetal weight greater than gestational age, with a fetal weight greater than 4,000 g or greater than 90 percentile. Several reports have reported a decrease in macrosomia after MBS. Marceau et al. [42] reported a decrease in macrosomia rate from

34.8% to 7.7% before and after BPD/DS for 638 infants. Maggard et al. [43] and Wittgrove et al. [44] reported a decrease in macrosomia rate after gastric bypass [43,44].

After MBS, women are at increased risk of nutrient deficiencies, including iron, folate, vitamin B12, and soluble vitamins. These deficiencies can lead to complications such as fetal neural tube defects, Wernicke's encephalopathy, fetal cerebral hemorrhage, or microphthalmia [42,45-47]. Patients undergoing procedures like BPD/DS should receive particular attention due to their higher risk of nutrient deficiency [45]. Therefore, routine prenatal multivitamin supplementation is advisable for mothers who have undergone MBS. Fetal growth should be monitored throughout each trimester, with vigilance for developmental issues such as congenital anomalies or fetal intracranial bleeding [47,48].

NUTRITIONAL SUPPLEMENTATION DURING PREGNANCY

Recommendation:

A. Regular monitoring of nutritional status and close collaboration with healthcare providers for proper nutrition supplementation in pregnant women following MBS are necessary to ensure the health and well-being of both the mother and the fetus.

Nutrition plays a vital role in the growth and development of the fetus, making it crucial during pregnancy. Maintaining a healthy, balanced diet helps ensure that both the mother and baby receive essential nutrients necessary for optimal health. Pregnant women require extra calories to support fetal growth and development, with the exact amount depending on factors such as pre-pregnancy weight, height, diet quality, nutritional status, and activity level [49]. Women who have undergone MBS are particularly vulnerable to various nutritional deficiencies during pregnancy. Therefore, it is important for these women to seek advice from healthcare professionals or registered dietitians who can provide personalized guidance based on their specific dietary concerns [50,51].

1. Recommended energy and macronutrients

According to a recent study, energy intake for pregnant women with a history of MBS varied significantly across trimesters. In the first trimester, caloric intake ranged from 1,385±415 to 1,971±430 kcal. The second trimester showed the widest variation, ranging from 1,222±425 to 1,978±427 kcal. By the third trimester, mean average caloric intake ranged from 1,514±503 to 1,881±835 kcal [52]. Protein intake averaged approximately 46.7 to 80 g/day across all trimesters [52]. The current recommendation for women with a history of MBS is >60 g/day, which does not take into consideration protein requirements for pregnancy [53]. There are no established recommendations for total caloric intake or other macronutrients in this population, highlighting the need for further research and guidelines in this area.

2. Recommended supplementation of micronutrients

Micronutrients are essential nutrients required in small quantities for the proper functioning of the body. During pregnancy, the demand for micronutrients increases to support the growth and development of the fetus and to maintain the health of the mother. The essential nutrients and their recommended minimum intake levels are as follows: copper (2 mg), zinc (15 mg), selenium (50 μg), folic acid (5 mg), iron (45–60 mg or >18 mg after AGB), thiamine (>12 mg), vitamin E (15 mg), and beta-carotene (vitamin A, 5,000 IU) [14,54-56]. The retinol

form of vitamin A should be avoided during pregnancy due to teratogenicity risk [57], and supplementation should be adjusted to maintain concentrations within normal limits [58]. Current recommendations for preconception nutritional supplementation are consistent with the guidelines provided by the British Obesity and Metabolic Surgery Society and the American Society of Metabolic and Bariatric Surgeons, and they reflect the widely accepted standard of care for micronutrient replacement [40,53,59].

During pregnancy, supplementation at 300 mg daily in combination with vitamin B complex may be necessary when there is prolonged nausea and vomiting due to hyperemesis. If oral supplementation is not feasible due to the severity of symptoms, intravenous thiamine should be administered at a minimum dose of 100 mg daily along with intravenous vitamin B complex. Additionally, supplementation with vitamin B12, iron, vitamin D, calcium, vitamin A, and vitamin K should be provided as recommended during the preconception period [60-62].

3. Monitoring interval for specific nutrients

Women planning pregnancy after MBS should undergo regular monitoring of the following parameters at least every 3 months to minimize the risk of potential deficiencies during the periconceptional period: serum folate, serum vitamin B12, serum ferritin, transferrin saturation, complete blood count, and serum vitamin A levels [40]. Additionally, prothrombin time, international normalized ratio (INR), serum protein levels, and serum albumin levels should be monitored every 6 months. If abnormalities are detected in coagulation studies, serum vitamin K1 concentration should also be monitored [63-66].

During pregnancy, maternal blood volume increases and the developing fetus imposes greater demands on both micronutrients and macronutrients, leading to decreased serum levels of many nutrients. Therefore, it is recommended to monitor the following parameters at least once per trimester using pregnancy-specific reference ranges to assess nutritional status: serum folate, serum vitamin B12, serum ferritin (including transferrin saturation), complete blood count, serum vitamin A, prothrombin time, INR, serum vitamin K1 concentration, serum protein, and serum albumin [64-67]. Additionally, it is advisable to monitor serum levels of vitamin E, zinc, copper, and selenium during the first trimester of pregnancy. Deficiencies in these nutrients have been associated with adverse pregnancy outcomes such as preeclampsia and preterm birth. Adequate levels of these nutrients support healthy fetal development and help reduce the risk of birth defects. Regular monitoring enables early detection of deficiencies and facilitates timely interventions to optimize maternal and fetal health [40].

4. Complications related to nutrient deficiencies

MBS alters the size or shape of the stomach and/or small intestine resulting in rapid weight loss. While the procedure can have many health benefits, it can also lead to nutritional deficiencies due to reduced intake and absorption of nutrients. Common deficiencies seen in pregnancies following MBS include iron, thiamine, and vitamins A, D, and K. Iron deficiency can lead to anemia, while inadequate thiamine intake may cause Wernicke encephalopathy [68,69]. Vitamin D deficiency poses risks of bone loss and dental issues for both mother and child [69]. Micronutrient deficiencies, particularly folic acid, vitamin K, and vitamin A, can result in neural tube defects, preterm births, cerebral hemorrhage, blindness, deafness, and growth retardation [38,54,70-72].

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To minimize the risk of nutrient deficiencies in pregnant women following MBS, close collaboration with healthcare providers is recommended. Regular monitoring of nutritional status and modification of diet and supplement regimen is also important. Regular prenatal care, including blood tests and ultrasounds, can contribute to ensuring the health and well-being of both the mother and the fetus.

PERINATAL MEDICAL MANAGEMENT

Recommendation:

A. Pregnant women with a history of MBS must inform the obstetrical team. A multidisciplinary antenatal approach is recommended and should include competent surgical advice if there is a suspicion of surgical complications (**Tables 1** and **2**).

1. Recommendations for fetal surveillance

The risk of SGA and prematurity of the fetus are increased after MBS [73-75]. Therefore, accurate determination of gestational age is crucial. An early ultrasound is a reliable method but any menstrual irregularities must be taken into account the theoretical gestational age is considered to be approximately 8 to 10 weeks in such cases). Pregnant women should have a standard monthly antenatal medical appointment.

The monthly antenatal care should be coordinated by an obstetrician and include regular assessment of fundal height at each appointment along with an additional ultrasound examination during the third trimester to screen for SGA. If there are clinical and/or ultrasound suspicions of SGA or additional risk factors for SGA, the evaluation and monitoring should be adjusted according to specific guidelines [76].

A multidisciplinary antenatal approach is recommended and should include competent surgical advice if there is a suspicion of surgical complications. Pregnant women with a history of MBS must inform the obstetrical team.

2. Screening and management of GDM

The recommended screening method and schedule for abnormal glycemia before and during pregnancy are summarized in **Table 1**. There are many specific considerations that should be considered in a pregnancy after MBS. Firstly, persistent excess weight remains a challenge for many women, contributing to an increased risk of abnormal glycemia before pregnancy and GDM [77-83]. Secondly, Second, fasting plasma glucose, which decreases after MBS [12,84,85] and hemoglobin A1c level, which is associated with an increased risk of perinatal morbidity/mortality (≥5.9%) [86,87], can be used during early pregnancy. Finally, 75 g-oral glucose tolerance test may not be well tolerated [88-90] and may induce hypoglycemia at 2h especially after RYGB [90]. Therefore, a 1-week self-monitoring of capillary blood glucose with samples before each meal, and alternately 1 or 2 hours after the start of each meal can be an alternative screening test after 24 weeks gestation [90,91]. Once diagnosed, GDM should be immediately managed by lifestyle modification, self-monitoring of blood glucose, and insulin therapy.

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Table 1. Recommended screening method and schedule for abnormal glycemia before and during pregnancy in women after MBS

Screening conditions	High-risk	General population	
Before pregnancy	FPG	FPG and HbA1c Normal if FPG <100 mg/dL and HbA1c <6%	
Early pregnancy	FPG GDM if FPG ≥92 mg/dL	FPG and HbA1c GDM if FPG ≥92 mg/dL and/or HbA1c ≥5.9%	
24–28 GW (only if early pregnancy test is negative)	75-g OGTT	Sleeve and AGB 75-g OGTT	OGTT is not well tolerated and RYGB: *One week of CBG monitoring with usual diet and physical activity levels
	GDM if ≥1 value from OGTT exceed diagnosis thresholds - FPG ≥92 mg/dL - 1 hour PG ≥180 mg/dL - 2 hours PG ≥153 mg/dL	GDM if ≥1 value from OGTT exceed diagnosis thresholds - FPG ≥92 mg/dL - 1 hour PG ≥180 mg/dL - 2 hours PG ≥153 mg/dL	GDM if ≥20% of all CBG exceed glycemic targets - Before meals ≥ 95 mg/dL - 1 hour PP ≥140 mg/dL - 2 hours PP ≥120 mg/dL 1 and 2 hours PP alternately
CBG targets if GDM diagnosed	- Before meals <95 mg/dL - 2 hours PP <120 mg/dL	- Before meals <95 mg/dL - 2 hours PP <120 mg/dL In case of RYGB: 1 and 2 hours PP alternately, with 1 hour PP <140 mg/dL	
Post-partum	75 g OGTT	FPG and HbA1c	

MBS = metabolic bariatric surgery, FPG = fasting plasma glucose, HbA1c = hemoglobin A1c, GDM = gestational diabetes mellitus, GW = gestational weeks, OGTT = oral glucose tolerance test, AGB = adjustable gastric banding, RYGB = Roux-en-Y gastric bypass, CBG = capillary blood glucose, PG = plasma glucose, PP = postprandial.

3. Recommended weight gain during pregnancy

There is currently no scientific evidence available regarding gestational weight gain and pregnancy outcomes specifically after MBS. Therefore, it is not feasible to recommend weight-gain guidelines different from those based on maternal BMI for the general population (**Table 2**) [17,92]. Dietary and sometimes psychological care should be reinforced if weight gain is below or above recommended targets.

4. Usage of medications after MBS during pregnancy

Gastric acid secretion inhibitors are often used after MBS to relieve or prevent symptoms of gastroesophageal reflux and reduce the risk of marginal ulcers. Currently, the most commonly used drugs are proton pump inhibitors. With the exception of omeprazole, lansoprazole, rabeprazole, pantoprazole, and exomeprazole are classified as grade B by the U.S. Food and Drug Administration in terms of fetal safety and can be safely used during pregnancy or lactation. There is still no known fetal safety regarding potassium-competitive acid blockers such as vonoprazan, which have been recently developed and used [93].

5. Attention to mental health and substance abuse

MBS is associated with an increased risk for mental health problems and substance abuse [94-96]. Data on mental health and substance abuse during pregnancies after MBS are very limited. Higher anxiety rates during pregnancy are reported, without significant increase in depression rates [97]. There was no data on postpartum depression following MBS. Overall smoking rate was 24%, without a clear relation to the type of procedure.

Table 2. Recommended weight gain during pregnancy according to the Institute of Medicine

Pregestational BMI (kg/m^2)	Mean weekly weight gain during the second and third trimesters (kg)	Total recommended weight gain during pregnancy (kg)
Underweight (<18.5)	0.5	12.5–18
Normal (18.5 to 24.9)	0.4	11.5–16
Overweight (25.0 to 29.9)	0.3	7–11.5
Obesity (≥30)	0.2	5–9

Adapted from the Weight Gain During Pregnancy: Reexamining the Guidelines [92].
BMI = body mass index.

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Smoking prevalence was comparable with the general nonpregnant female population, but much higher than in the general pregnant population in the same region (6%). No studies were found reporting on alcohol or other substance abuse during pregnancies after MBS. As such, we recommend health providers to screen for anxiety and other mental health disorders prior and during pregnancy, and follow-up should be offered when necessary. Smoking cessation and alcohol use should be discussed when necessary as per general pre-pregnancy guidance.

PERINATAL SURGICAL MANAGEMENT

Recommendation:

A. Awareness and high degree of suspicion for possible surgical complications after MBS during the perinatal period is critical for timely management.

Surgical complications in pregnancy after MBS have various risks depending on the type of surgery. These symptoms may mimic common symptoms of physiological changes during pregnancy and require vigilant management. Pregnant women presenting with abdominal pain require special attention. Pregnant women should be assessed by a bariatric surgeon for potential issues such as AGB slippage/erosion, internal hernia after RYGB, small bowel obstruction and intussusception.

1. Awareness and high degree of suspicion for internal herniation after RYGB

RYGB creates mesenteric defects with internal spaces predisposing patients to internal herniation. Pregnant women with a history of RYGB therefore have a risk for internal herniation at an incidence reaching 5–10% [40,98-100]. The most common location is the Petersen's space [98]. Upper abdominal pain is a common symptom of internal herniation, affecting 46% of pregnant women with a history of RYGB, with 32.8% of these cases being diagnosed as internal herniation [101]. The abdominal pain may be accompanied with nausea, vomiting and/or abdominal distension. These symptoms can progress to bowel ischemia if the diagnosis is delayed leading to peritonitis and sepsis.

In the case of acute abdominal pain that is difficult to determine by physical examination alone, magnetic resonance imaging (MRI) should be the first-line imaging option in cases of diagnostic uncertainty. If MRI is unavailable, a computed tomography (CT) scan with contrast should be performed without delay [16]. The radiation exposure during a CT scan can vary depending on the technique but a radiation dose of 25 mGys is considered to be tolerable in emergencies after the 2nd and 3rd trimesters [102]. However, the utilization of intravenous contrast at any stage of pregnancy is known to cross the placenta and can enter the fetal circulation and amniotic fluid. The teratogenic and mutagenic effects of iodinated contrast media are undetermined. Therefore, intravenous contrast should be recommended only in clinical situations that absolutely require it for additional diagnostic information [103]. As the effects of radiation are at its greatest during the first trimester, MRI with or without hospitalization for surgical observation is recommended. A CT scan with minimized radiation doses can be recommended for patients in the second and third trimesters [102]. These imaging techniques were only 75% accurate in diagnosing internal hernias during pregnancy [104]. Even if no abnormal findings are found in MRI or CT scan, hospitalization and surgical observation should be recommended.

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When an internal hernia is suspected, patients should receive prompt pain management with close monitoring. Acute surgery may be required if there is persistent pain despite fasting and medical treatment and subacute surgery should be considered if pain recurs after resumption of diet. Laparoscopy is an excellent diagnostic as well as therapeutic modality.

Women with a history of RYGB should be advised about the risks and symptoms of internal herniation so that they seek medical assistance without delay when needed. Patient education should include clinical signs that warrant urgent surgical examination. These patients should be assumed to have a small bowel obstruction due to internal herniation until proven otherwise when presenting with abdominal pain during pregnancy. Clinicians should maintain a high suspicion for internal hernias in patients with a history of RYGB. Imaging techniques and operative intervention should not be delayed.

2. Management of incisional hernia during pregnancy

Indications for surgical treatment of incisional hernia in pregnant women who have undergone MBS are the same as in women during general pregnancy. When incisional hernia develops during pregnancy, treatment depends on gestational age and symptoms. Pregnant women are generally recommended to be treated surgically during pregnancy only in cases of herniation with complications such as incarceration or strangulation. In the 1st or 2nd trimester, surgical repair should be considered if it is difficult to maintain pregnancy due to symptoms and size of the defect. In the 3rd trimester with symptomatic and/or irreducible hernia, it can be assessed whether to perform an emergency cesarean section along with hernia repair or to delay the delivery until term after emergency hernia operation [105].

3. Management of AGB during pregnancy

There is no definitive recommendation on the optimal gastric band adjustment during pregnancy. Inflating the band may reduce maternal complications such as weight regain, however it may also negatively impact fetal growth. Conversely, deflating the band may prevent band-related complications, but it could cause excessive weight gain and increase risk of macrosomia and GDM [106]. However, if a woman experiences vomiting or poor weight gain during pregnancy, deflation of the band may be necessary [29]. Therefore, it is not recommended to deflate or inflate the gastric band throughout pregnancy and band adjustment should be based on individual considerations [21,107,108].

Late complications of AGB include band erosion, band slippage or prolapse, port or tubing malfunction, leakage at the port site tubing or band, pouch or esophageal dilatation, esophagitis, and hiatal hernia [109]. Almost 50 percent of patients will need surgical revision or removal of the band [110]. These complications can also occur during pregnancy, and in general, they can occur more as abdominal pressure increases after pregnancy.

Gastric band slippage after AGB is one of common surgical complications during pregnancy. According to a study, the incidence of gastric band slippage during pregnancy was 12%, higher than the 3% to 5% incidence observed in the general population who underwent AGB [111]. The risk of gastric band slippage increases during pregnancy due to increased intra-abdominal pressure and vomiting. Therefore, patients should be informed of the symptoms and risks during pregnancy and postpartum. An MRI is advisable if gastric band slippage is suspected. If MRI facilities are not easily accessible, there should be no delay in performing abdominal X-ray, esophagram or CT scan.

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Another fatal complication is band erosion with bleeding. Gastric band erosion usually occurs in 1% of patients about 22 months after surgery [112,113]. Epigastric pain and hematemesis are dangerous symptoms and are confirmed through endoscopy. Once diagnosed, the principle is to remove the band to prevent further complications. Although there are no exact guidelines on this matter during pregnancy, it should be performed as an emergency procedure if required.

CHOOSING AN APPROPRIATE MEDICAL INSTITUTION AND MODE OF DELIVERY

Recommendations:

A. Pre- and perinatal care from an accredited institution certified by the society or an institution where a certified metabolic and bariatric surgeon works is recommended.

B. Planning for mode of delivery in women after MBS should follow standard guidelines and a history of MBS should not be considered as an indication for a cesarean delivery.

1. Appropriate medical institution

Both obstetricians and surgeons should consider these pregnant women as high-risk pregnancies. Even though the patient is now overweight or still obese instead of morbidly obese, intensive management during the preconceptional, prenatal, and postpartum periods is recommended [50]. Women should ideally have a consultation before conception, or as soon as pregnancy is diagnosed, with a physician with expertise in the management of post-bariatric patients [16].

In pregnancy, there may be a delay in the diagnosis of bariatric-related operative complications. These complications include anastomotic leaks, bowel obstructions, internal hernias, ventral hernias, band erosion, and band migration. All gastrointestinal problems such as nausea, vomiting, and abdominal pain, which occur commonly during pregnancy, should be thoroughly evaluated in patients who have had MBS. Early involvement of the bariatric surgeon in evaluating abdominal pain is critical because the underlying pathology may relate to the weight loss surgery [107]. Because of the risk of delayed postoperative complications, gastrointestinal problems that are common in pregnancy (e.g., nausea, vomiting, abdominal pain) require thorough evaluation in women who have undergone MBS. Early consultation with a bariatric surgeon is critical to determine whether the symptoms are related to the surgery [114].

Follow-up with a multi-disciplinary approach increases the chances for a successful pregnancy outcome [50]. Therefore, it is recommended to receive intensive management through a multidisciplinary approach at an institution with a metabolic and bariatric surgeon. In Korea, the KSMBS implements the metabolic and bariatric surgeon certification system and institutional certification system. In conclusion, pre- and perinatal care from an accredited institution certified by the society or an institution where a certified metabolic and bariatric surgeon works is recommended.

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2. Mode of delivery

Cesarean delivery rates in pregnancies after MBS have been reported higher than in the general population [115-117]. Women who undergo bariatric procedures are typically older and more likely to be obese than women in the general obstetric population [77,118]. Both age and obesity are risk factors for cesarean delivery. Several studies of cesarean delivery rates have reported that cesarean delivery rates tend to be either similar to or lower than the rates in obese women who have not undergone MBS [73,118-120]. There is no established medical evidence for women who have undergone MBS to need to have more cesarean sections. Therefore, MBS itself should not be considered an indication for cesarean delivery [14,56,107]. Planning for mode of delivery in women after MBS should follow standard guidelines.

POSTPARTUM PERIOD

Recommendations:

A. Breastfeeding after MBS is not compromised and should be encouraged.
B. Post-bariatric women are encouraged to receive regular monitoring of nutrients and adhere to nutritional supplementation guidelines (**Table 3**).
C. Psychological assistance for women with a history of MBS should be provided during the pregnancy-puerperal period to prevent the development of mental disorders and their impacts on maternal-child health.

1. Breast feeding

Breastfeeding generally provides numerous benefits to mothers and infants. Maternal health benefits include lower risk of diabetes, hypertension, obesity, heart disease, hyperlipidemia, and gynecological malignancies. It helps women to return to pre-pregnancy weight earlier, decreases postpartum bleeding, and protects infants from bacteremia, infection, necrotizing enterocolitis, sepsis, and diabetes [121,122]. Additionally, maternal weight loss after MBS and concomitant breastfeeding reduce the risk of obesity in their offspring [123,124]. One study found that children born to mothers who had undergone RYGB and who were breastfed for at least 6 months demonstrated lower fat mass and lower glucose levels, possibly reducing their risk of obesity and related comorbidities later in life [125]. These authors also recommend breastfeeding in these women for at least 6 months, which is in line with the statements described in World Health Organization guidelines.

Although women after MBS may be considered at a higher risk for reduced absorption and poor dietary intake, the nutrition counseling that patients receive before and after surgery may improve the nutrient composition. Overall, the composition of breast milk from women after MBS appears to be adequate in energy, macronutrients, and vitamin A during the first six weeks of lactation and can be considered generally comparable to those without a history of MBS [126,127].

2. Appropriate nutritional supplementation during lactation

Breast milk production can be inadequate for women after MBS for the following reasons. Consuming less than 1,500 kcal/day can decrease milk production and achieving this caloric goal can be relatively difficult for post-bariatric patients due to their lower food

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retaining ability and potential psychological reluctance. Additionally, prolactin levels in bariatric women significantly decrease one year after surgery (especially SG and BPD/DS). Consequently, low prolactin levels result in glucose intolerance, impaired milk production, and insulin resistance during lactation. The caloric cost of producing 725 mL of breast milk is 500–670 kcal/day, but it can be difficult for lactating women after MBS to meet their energy needs. During lactation, the maternal bloodstream provides nutrients for generating breast milk first, and then for the mother's own use. Thus, lactating women with a history of MBS should be advised to take dietary supplements postnatally to provide adequate nutrition [128].

MBS itself can hinder appropriate absorption of nutritional elements. Since the first part of duodenum absorbs fat-soluble vitamins, post-bariatric women with bypassed intestinal tracts easily experience problems absorbing the vitamin D [129]. While, water-soluble vitamins, such as vitamin B12 is absorbed in the colon and stomach secretes gastric juice and intrinsic factor (IF) responsible for absorption of vitamin B12. Women after MBS with small pouches inevitably have impaired IF functions. The prevalence of iron deficiency was reported to be 18–53% after RYGB and 1–54% after SG [130]. Therefore, regular monitoring and effective treatment options for iron deficiency are crucial to successfully manage the iron status of breastfeeding women after MBS. Moreover, specific micronutrient monitoring, supplementation of daily multi-vitamin, calcium, vitamin D, vitamin B1 (thiamine), vitamin B12, and iron should be recommended. Post-bariatric women are encouraged to follow the supplementation guidelines summarized in **Table 3** [40,130-133].

Table 3. Guidelines for nutritional supplementation in the postpartum period after MBS

Type of supplement	Specifications
MVM supplement	Complete formula including folate, zinc, and copper A minimum of 18 mg iron, 400 μg folic acid, selenium and zinc in each serving Iron containing MVM supplement is advised to be taken 2 hours apart from calcium supplements
Iron	Elemental iron, 18–27 mg/day; 45–60 mg for menstruating females Avoid excessive intake of tea (tannin) which impairs iron absorption Vitamin C intake would enhance iron absorption
Calcium	Elemental calcium, 1,500–2,400 mg/day Calcium supplements with vitamin D3 are recommended; 500 mg per serving, split doses throughout the day AGB, SG and RYGB: 1,200–1,500 mg BPD/DS: 1,800–2,400 mg with magnesium
Vitamin A	AGB, SG and RYGB: 5,000–10,000 IU BPD/DS: 10,000 IU
Vitamin B1 (thiamine)	At least 12 mg/day
Folic acid (folate or vitamin B9)	If taking separately from MVMs, 800–1,000 mg oral folate daily
Vitamin B12	If not receiving intramuscular injection, oral tablets of 350–500 μg/day is the general guidance but dosages may vary indicated by type of procedure
Vitamin D	A maternal dose of 160 μg/day (6,400 IU/day) of vitamin D is suggested The recommended dietary allowance for vitamin D is 600 IU/day or 15 μg/day and supplementation should vary based on maternal diets, and their baseline & post-operative vitamin D levels. A dosage of 3,000 IU or higher is necessary to achieve serum level of >30 ng/mL. Serum parathyroid hormone is kept within normal limits when serum vitamin D levels are over 50 ng/mL [13]
Vitamin E	15 mg for all patients
Vitamin K	AGB, SG and RYGB: 90–120 ug BPD/DS: 300 ug

MBS = metabolic bariatric surgery, MVM = multivitamin/mineral, AGB = adjustable gastric banding, SG = sleeve gastrectomy, RYGB = Roux-en-Y gastric bypass, BPD/DS = biliopancreatic diversion with duodenal switch.

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3. Emotional support for postpartum depression

Mental health disorders during the pregnancy-puerperal cycle are associated with poor maternal and infant outcomes surrounding delivery [134-136]. Postpartum depression, especially, may result in a lesser adherence to the role of mother and negatively impact the quality of the mother-child relationship affecting the child's psychosocial development [19,137].

Women with a history of MBS are more likely to have postpartum depression during the pregnancy-puerperal cycle particularly in the first and third trimesters of pregnancy. The degree of depressive symptoms can vary depending on marital status, desired or undesired pregnancy, and a history of psychiatric disorders. After MBS, single women had three times more chances to show postpartum depression compared to that of married women. Women with a psychiatric history had double the chances of showing depressive symptoms than those without. Planned and desired pregnancy could prevent maternal symptoms of depression [137]. Compared to obese women without MBS, anxiety symptoms were higher in the post-bariatric patients. Anxiety became worse in women with more weight loss after MBS, a higher frequency of sleep disorder, and a history of smoking [97].

Women who underwent MBS were reported to commonly have a history of psychiatric disorder, such as compulsive behaviors, binge eating, bulimia nervosa, and anorexia nervosa [137]. Sleep disturbances are common in pregnancy and are associated with elevated pre-pregnancy BMI [138,139]. Therefore, women after MBS are prone to have poor quality and reduced duration of sleep. These women's difficulties during maternal adaptation to physical, mental and social transformation may result in a higher emotional ambivalence with both the desire for returning to the perfect body obtained through MBS prior to pregnancy and the wish to fulfill the new role as mother.

Taken together, psychological assistance for pregnant women with MBS should be highlighted to prevent development of postpartum depression or anxiety and enhance the quality of the maternal-child relationship. For this purpose, marital status, planned and desired pregnancy, and psychiatric history should be checked by the professionals involved. Early recognition and strategic orientation for pregnant women after MBS is essential to minimize the negative impacts on maternal and infant care. Interestingly, one study reported that 15.2% of women who received psychopharmacologic treatment during their pregnancy had only 7.6% of postpartum depression, demonstrating the importance of early recognition and treatment [140].

On the other hand, the correlation between the severity of postpartum anxiety and poor consumption of polyunsaturated acids, folate, and vitamin B12 has not yet been elucidated [20]. Both eicosapentaenoic acid and docosahexaenoic acid supplementation could not provide a benefit on maternal depression and anxiety symptoms [141]. Future studies are expected to reveal the relationship between maternal nutritional status such as fat profile, folate, vitamin B12 and postpartum mental health after MBS.

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CONCLUSIONS

1. Summary of statements and recommendations

1. Procedure selection of MBS in women of reproductive age

A. Procedure selection should be done based on the patient's current BMI, comorbidities, and patient preference. Patients who plan on a future pregnancy should understand the possible surgical complications related to malabsorptive procedures and AGB.

2. Fertility after MBS

A. Education of increased fertility and the appropriate method of contraception should be carried out for all patients of reproductive age before MBS.

B. Oral contraceptives increase perioperative thrombotic risk and should be discontinued 4 to 6 weeks before and 6 weeks after MBS. Parenteral LARC methods are effective and easily applicable first line methods for contraception after MBS.

C. Pregnancy is recommended after a minimum of 12 months after MBS until body weight loss is stabilized.

3. Nutritional supplementation during pregnancy

A. Regular monitoring of nutritional status and close collaboration with healthcare providers for proper nutrition supplementation in pregnant women following MBS are necessary to ensure the health and well-being of both the mother and the fetus.

4. Perinatal medical management

A. Pregnant women with a history of MBS must inform the obstetrical team. A multidisciplinary antenatal approach is recommended and should include competent surgical advice if there is a suspicion of surgical complications (**Tables 1** and **2**).

5. Perinatal surgical management

A. Awareness and high degree of suspicion for possible surgical complications after MBS during the perinatal period is critical for timely management.

6. Choosing an appropriate medical institution and mode of delivery

A. Pre- and perinatal care from an accredited institution certified by the society or an institution where a certified metabolic and bariatric surgeon works is recommended.

B. Planning for mode of delivery in women after MBS should follow standard guidelines and a history of MBS should not be considered as an indication for a cesarean delivery.

7. Postpartum period

A. Breastfeeding after MBS is not compromised and should be encouraged.

B. Post-bariatric women are encouraged to receive regular monitoring of nutrients and adhere to nutritional supplementation guidelines (**Table 3**)

C. Psychological assistance for women with a history of MBS should be provided during the pregnancy-puerperal period to prevent the development of mental disorders and their impacts on maternal-child health.

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2. Practice guidelines and standard of care

This position statement has been developed by the KSMBS to assist in the care of women of childbearing age who are planning to undergo or have undergone MBS. It is intended to serve as a guideline and should not be interpreted as a set of inflexible rules or mandatory requirements for practice. Additionally, this statement is not designed to establish local, regional, or national legal standards of care and should not be used for such purposes.

We acknowledge that each patient presents with unique circumstances, and there are various appropriate treatment modalities available. Physicians are encouraged to use their professional judgment in selecting the most suitable treatment option tailored to the individual needs of their patients. Choosing an approach that differs from this position statement does not inherently indicate a deviation from the standard of care; rather, it reflects the physician's responsibility to provide the best possible care based on current knowledge, available resources, and specific patient conditions.

The primary goal of this position statement is to support healthcare providers in delivering effective and safe medical care to their patients. We advise caution against using this document in litigation contexts where clinical decisions are under scrutiny. Ultimately, physicians should strive to follow a reasonable and evidence-based course of action that prioritizes the well-being and safety of their patients.

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