

Bariatric Surgery in Women: A Boon Needs Special Care During Pregnancy

ARCHANA KUMARI¹, ARUNA NIGAM²

ABSTRACT

Obesity is one of the leading causes of health related disorder and has reached epidemic proportions not only in developed nations but also in developing countries like India. Bariatric surgery has become a popular alternative for obese women planning pregnancy. A multidisciplinary approach involving the obstetrician, the bariatric surgeon and the nutritionist is required to manage pregnancy following bariatric surgery. Early consultation should be done to determine baseline nutritional status and the importance of regular check-ups must be explained. Nutritional supplementation should be tailored to the patient's status and the type of bariatric surgery performed.

Keywords: Gastroplasty, Maternal obesity, Metabolic syndrome

INTRODUCTION

Obesity is defined as body mass index (BMI) ≥ 30 kg/m². Severe obesity occurs when BMI is 35–39.9 kg/m² while morbid obesity is BMI ≥ 40 kg/m². Obesity is one of the leading causes of health related disorder and has reached epidemic proportions not only in developed nations but also in developing countries like India where morbid obesity affects atleast 5% of the population. The prevalence of morbid obesity increased by 50% in the United States from 2000 to 2005 [1]. The World Health Organization estimates that 54.3% of the women and 51.7% of the men in the USA will be obese in 2015. Overall prevalence of obesity in India among women is 12.6% according to NFHS 3 in 2005-6 [2]. The prevalence of obesity is increasingly rapidly among women all over the world and affecting more commonly the reproductive age group.

CONCERNS

It is a life-threatening condition as it shortens life expectancy by being the harbinger of several chronic illnesses like diabetes mellitus, heart disease, hypertension, osteoarthritis and cancers [3]. Apart from causing menstrual disorders, infertility and miscarriages, psychological issues, obesity has been associated with increased risk of almost every complication of pregnancy.

The aim of the review is to estimate the incidence of bariatric surgeries in the reproductive age group and to assess the effect of these on the fertility and fetomaternal outcome. Reviews, original articles and case reports were identified by searching PUBMED from 1995 to January 2015 using the keywords 'pregnancy outcome after bariatric surgery and finally 48 articles have been referred.

IMPLICATION OF MATERNAL OBESITY

Maternal obesity is defined as BMI ≥ 30 kg/m² at the first antenatal visit. Recently, it has been recognised as a major risk factor in obstetric practice with the escalating prevalence of overweight and obese women in the reproductive age group. Pre-pregnancy obesity also poses significant risk for both adverse maternal and perinatal outcomes [4,5] as shown in the [Table/Fig-1].

The combination of pre-gestational metabolic syndrome and the physiological changes of pregnancy cause an increased risk

Early Pregnancy	Late Pregnancy	Labour & postpartum	Fetal & Perinatal Issues
Spontaneous abortions [6]	Gestational diabetes mellitus	Dysfunctional labour	Macrosomia [7]
Congenital anomalies [8]	Pregnancy induced hypertension	Increased operative interventions [9,10]	Birth trauma Shoulder dystocia [8,10]
	Increased risk of medical problems	Anaesthetic complications	Juvenile obesity [10]
	Still births/ intrauterine death [11]	Wound sepsis Deep vein thrombosis	Adolescent and adult metabolic syndrome [12]
		Postpartum haemorrhage	

[Table/Fig-1]: Fetomaternal complications in obese pregnant women

for medical complications such as chronic cardiac dysfunction, proteinuria, sleep apnea, and non-alcoholic fatty liver disease [13].

Weight Loss Measures and Their Efficacy

Weight loss before conception is the optimum way to avert the medical and obstetric complications in obese women. Lifestyle modification as well as medical therapy had limited success in maintaining long-term weight loss. Bariatric surgery has become a popular alternative for obese women planning pregnancy. There is scanty data pertaining to the pregnancy outcome after bariatric surgery especially from India.

Weight loss has been found to markedly decrease the incidence of all obesity related disorders [14]. Lifestyle modifications like diet and physical exercise even if supported with medications are not very effective at producing significant weight loss and thereafter maintaining it in patients with severe obesity. They produce only modest weight loss (5 kg lost at one year) [15]. Controlled studies of diets have also shown only minimal weight loss [16]. However, surgical treatments for severe obesity have been reported to cause not only substantial but also sustainable weight loss over the long term. A meta-analysis published in 2005 reported that bariatric surgeries result in 20–30 kg of weight loss that can be maintained for at least 10 years [17].

BARIATRIC SURGERIES

The effectiveness of bariatric weight loss surgeries has already been well publicized by patients, success stories, and the media. As a result, more obese patients have been overwhelmingly opting for the procedures and a marked rise in these operative interventions has been reported in the USA especially among women [18]. Furthermore, a 5-fold increase was noted among teenager females [19]. As a result, it is worthwhile to expect an increased population of pregnant women post bariatric surgery with altered nutritional requirement demanding rigorous scientific research into pregnancy and neonatal outcomes in this population. Although there are very few studies from India [20,21] in the last 10 years on this subject but this surgery is increasing especially in metros and we will be facing the challenge of treating these pregnant women more often in near future.

BARIATRIC SURGICAL PROCEDURES

- RESTRICTIVE:** These procedures restrict the food intake and achieve weight loss due to early and prolonged satiety after a solid meal.
 - Laparoscopic Adjustable Gastric Banding (LAGB):** In this surgery the uppermost portion of the stomach is encircled by a band made up of an inflatable balloon, thereby decreasing the gastric volume. The diameter of this balloon can be altered by adding or removing saline as a daycare procedure depending on the rate of a patient's weight loss [22].
 - Gastroplasty: Laparoscopic sleeve resection (gastrectomy)/vertical band gastroplasty (VBG):** In this the upper part of the stomach is stapled to create a narrow gastric inlet or pouch which causes sense of fullness after eating small meals [23]. VBG has now been superseded by adjustable band procedures and procedures that combine mechanical restriction with bypass because of the poor long-term weight loss and complications.
- MALABSORPTIVE:** These procedures bypass a certain length of intestine so that the food and digestive juices come in contact with only a short length of bowel causing malabsorption of the food and thus weight loss. The procedures include
 - Bilio-pancreatic diversion [23,24]:** Here, 70% of the stomach is removed and a significant proportion of small intestine is bypassed which leads to malabsorption especially of fats caused by–
 - Diversion of food downstream thereby decreasing nutrient absorption.
 - Reduction in the quantities of enzymes and bile in the bypassed segment, which decreases absorption.
 - Bilio pancreatic diversion with duodenal switch:** This is rarely performed now due to substantial long term complications of hepatic failure, renal failure, kidney stones, arthritis and malnutrition.
- Combined Restrictive And Malabsorptive:** Roux en Y gastric bypass [25,26]: In this procedure, a part of stomach, whole of the duodenum and 40-150 cm of the proximal jejunum are bypassed resulting in reduced absorptive area as well as changes in hormones (e.g., Ghrelin, PYY) and neural signals to the gastrointestinal tract leading to hunger control and satiety. Patients generally develop an aversion to high-carbohydrate diet and make major changes in their diet and eating habits.

BARIATRIC SURGERY AND PREGNANCY OUTCOME

Maternal Outcome: On extensive literature search, three cohort studies were found which compared outcomes between patients with post bariatric surgery pregnancies and nonsurgical patients who delivered in the same period and were matched to one or more characteristics like body mass index and age [27-29].

Medical complications: Most studies reported reduced incidence of gestational diabetes mellitus (GDM), Pregnancy induced hypertension and pre-eclampsia.

Rate of caesarean section: Although caesarean section rate does not increase after bariatric surgery as such but a study by Dixon et al., found rate significantly higher in post bariatric surgery patients [30].

Miscarriage: No significant difference was observed in miscarriage rate after BPD procedure [31] however restrictive procedures have reported that miscarriage rates remain high and vary from 4.3% up to 29% despite reduction in BMI [30-33].

Gestational Weight Gain: The weight gain in post bariatric pregnancies can vary widely. It is probably affected by the time period between surgery and conception [34]. Several case-control studies have demonstrated a significantly lower weight gain after bariatric surgery compared with a BMI-matched control group or to pregnancies prior to surgery. It has been recommended to do active band adjustment (by removing all band fluid in 1st trimester to prevent vomiting, addition of fluid after 14 weeks gestation or later if weight gain was excessive and then again removal of all fluid at 36 weeks to minimize its impact on delivery) for favourable maternal weight outcomes [30].

Nutritional Deficiencies: Although mild nutrient deficiency is common after bariatric surgeries, the risk for clinically relevant micro/macro nutrient deficiencies increases during pregnancy because of increased requirements that are exacerbated by serious nausea-vomiting during pregnancy. Malnutrition is more common after malabsorptive procedures than restrictive ones. There are studies who have raised concerns over some specific nutrient deficiency in pregnancy [35].

[Table/Fig-2] summarizes the specific deficiencies and their consequences in pregnant women.

Deficiency	Consequences
Protein	Hypoalbuminemia in mother Fetal growth retardation Oligohydramnios Fetal deaths
Vitamin K	Fetal intracerebral haemorrhages
Vitamin A	Fetal bilateral microphthalmia and permanent retinal damage
Vitamin B12 (seen after all surgical procedures)	Maternal anaemia in pregnancy Low B 12 levels in breast milk
Electrolytes and calcium	Electrolyte imbalance in baby
Fat malabsorption	Poor energy content of breast milk leading to poor postnatal growth
Iron	Iron deficiency anaemia

[Table/Fig-2]: Specific deficiencies and their consequences in pregnant women after bariatric surgery

Enteral and/or parenteral nutrition along with specific supplementation of micronutrients is indicated during pregnancy.

Mechanical Complications After Restrictive Procedures: The vomiting tendency in pregnancy, increased abdominal pressure and the anatomical repositioning of the intra-abdominal organs during pregnancy predispose to technical problems with the gastric band. Band migration with resultant vomiting, dehydration, electrolyte disturbances and band leakage has been reported in up to 29% of case [30].

Surgical Complications: Several complications have been reported requiring surgical intervention during pregnancy following bariatric surgery i.e. intestinal obstructions (due to adhesions from previous surgery), intestinal hernia (due to increased intraabdominal pressure), gastric ulcer, band events and staple line stricture [17]. Intestinal obstruction can occur at three stages: at mid pregnancy when the uterus becomes an abdominal organ and puts pressure on the intestine; at term when the fetal head descends; and in the post-partum period with rapid involution of the uterus [36]. In cases of an intestinal hernia or obstruction, prompt recognition and intervention is required for survival of both mother and child. Although CT scan is contraindicated during pregnancy but it may be done to confirm the diagnosis in the event of uncertainty to save the maternal mortality.

NEONATAL OUTCOME

Birth Weight: Pregnancy following bariatric surgery has been demonstrated to reduce fetal macrosomia especially after Roux en Y gastric bypass [22,23]. Increased incidence of intrauterine growth restriction and small for gestational age has been observed after bariatric surgery [37].

Premature Birth: There are conflicting reports regarding prematurity. But many studies have seen no significant change in the prematurity rate in post bariatric surgery pregnancies [18,24].

Perinatal Death: Perinatal mortality rate does not differ in pregnancies with and without previous bariatric surgery [26].

Congenital Malformations: A number of observational studies indicate the need for further research into the potential increase in congenital malformations following bariatric surgery. Two studies have reported increased rate of neural tube defects following RYGB because of non-adherent to recommended vitamin supplementation [38,39].

MANAGEMENT RECOMMENDATIONS FOR PREGNANCY AFTER BARIATRIC SURGERY

Timing of Pregnancy After Bariatric Surgery: Although there is paucity of literature that suggest any optimal timing for pregnancy after bariatric surgery, Currently it is highly recommended to delay pregnancy for 12–18 months after surgery, because of a rapid weight loss phase and its specific stressful influence on the organs [33]. If conception occurs within a period of rapid weight loss, there are concerns about increased miscarriage rate and reduced fetal growth. However, spontaneous miscarriages or stillbirths were neither noted within the early or late group, although preterm deliveries occurred with higher frequency in pregnancies conceived within the first year after surgery [29]. No difference has been observed in the incidence of GDM, PIH and CS, birth weight, IUGR or SGA, between early or late groups [30,34].

The patients should be advised effective contraception as oral contraceptives may not achieve adequate levels of their active substances in serum, because of altered absorption [40].

It is mandatory that patients should remain in regular follow-up following bariatric surgery in order to ensure a healthy and varied diet with folic acid, vitamin B12 and iron supplementation.

Antenatal Care: A multidisciplinary approach involving the obstetrician, the bariatric surgeon and the nutritionist is required to manage pregnancy following bariatric surgery. Early consultation should be done to determine baseline nutritional status and the importance of regular check-ups must be explained.

Nutritional supplementation should be tailored to the patient's status and the type of bariatric surgery performed. Congenital malformations must be ruled out by a targeted scan. Close monitoring of gestational weight gain and fetal growth should be done by serial ultrasound examination. There should be high index

of suspicion whenever patient present with epigastric pain, nausea, post-prandial vomiting and intestinal obstruction must be ruled out without delay.

There is an increased requirement for microelements and vitamins during pregnancy which becomes evident and more important in those women who have undergone bariatric procedures. The compliance of long term intake micronutrient and multivitamin is poor in a bariatric surgery patients thus proper prenatal counselling and treatment regarding this aspect is mandatory. These women have higher risk of complications caused by deficiencies of vitamin B12, folic acid, calcium, and iron especially [41].

Calcium supplementation: Inadequate calcium intake can cause maternal bone loss, reduced calcium in breast milk, or inappropriate mineralization of fetus bones. Thus, it is recommended to increase the intake of 1000 mg of calcium during pregnancy to 2000 mg of calcium citrate with vitamin D (50–150 mcg). The citrate form is preferred as it does not require acidic environment for absorption [42].

Iron supplementation: Iron deficiency in these patients is caused by achlorhydria or bypass of duodenum and proximal jejunum which are the first and main site of the iron absorption [43]. The important points to remember during supplementation in these patients are–

- Ferrous form should be supplemented to avoid the need of acidic environment.
- Recommended 30 mg of daily iron supplementation to be increased to 40–65 mg daily.
- Regular estimation of serum levels of haemoglobin, iron, ferritin, and transferrin is mandatory so that the dose of Iron can be modified accordingly.

Vitamin B12 supplementation: Vitamin B12 deficiency occur due to the absence of acid environment, inadequate secretion of intrinsic factor (IF) and malabsorption [44]. Besides causing anaemia the B12 deficiency may also result in early pregnancy losses, neurobehavioral disorders and anaemia in infant due to rise in maternal serum homocysteine levels caused by low concentration of cobalamin thus regular estimation of serum homocysteine and vitamin B12 levels is mandatory [45]. The recommended daily sublingual dose of cobalamin during pregnancy after bariatric surgery should be increased from 3 mcg to 10 mcg in easily absorbed crystalline form. Intramuscular injections in monthly dose 1000 mcg can also be used.

Folic acid supplementation: Prenatal supplementation with vitamins containing 4 mg of folic acid prior to and during pregnancy is usually sufficient to maintain adequate serum levels to reduce the risk of neural tube defects.

Vitamin A supplementation: It is reported that this deficiency exists in 10% of patients following gastric bypass [46]. Vitamin A plays an important role in cell's reproduction, differentiation, and proliferation. Vitamin A is also needed for normal fetal lung development and maturation. Moreover, vitamin A deficiency also increases susceptibility to respiratory infections and diarrhea. Vitamin A stores in the fetal liver is affected by the maternal vitamin A levels thus plasma retinol levels must be examined periodically and if necessary oral supplement therapy in dose of 5000 IU/day can be given [47].

Vitamin K supplementation: Excessive vomiting or fat malabsorption may lead to a higher risk of vitamin K-deficient bleeding disorders of the neonates. Eerdekens et al., reported on five cases with severe intracranial bleeding and skeletal malformations caused by vitamin K deficiency of mothers following bariatric surgery [47]. However, there are no recommendations about supplementation of the vitamin K [45].

Zinc supplementation: Recommendations is same as in routine pregnant woman.

Iodide supplementation: There are no recommendations for the pregnant women after bariatric treatment. Due to the threat of malnutrition the daily intake of 250 mcg of iodide is recommended as against 150 mcg in routine pregnancy.

Gestational Diabetes: The screening for gestational diabetes mellitus in these patients is done by fasting and postprandial blood sugar levels or continuous blood glucose monitoring to avoid the risk of dumping syndrome (nausea, abdominal cramps, diarrhea, and heart palpitation) associated with glucose tolerance test [48].

Weight Gain: According to the Institute of Medicine of the National Academy of Sciences–

- Normal-weight women (BMI of 19.8–26): recommended weight gain is 11.5–16 kg,
- Overweight women (BMI of 26.1–29): recommended weight gain is 7–9 kg.

Fetal ultrasound scans every 4 to 6 weeks starting from the 24th week of gestation is recommended to monitor fetus growth [34].

Intrapartum: A normal and uncomplicated course of labour is expected in the post bariatric surgery pregnant women.

Postpartum: Mothers after bariatric surgery should be encouraged to breastfeed as in non obese postpartum women. It is essential to maintain micronutrients supplementation during breastfeeding to prevent fetal vitamin deficiency especially vitamin B deficiency, which can cause megaloblastic anaemia, failure to thrive and development delays. Entire period of breastfeeding should be under special medical care the same as pregnancy.

CONCLUSION

Pregnancy after bariatric surgery should be managed by team of experts involving the obstetrician, the bariatric surgeon and the nutritionist. It is advisable to delay pregnancy for 12-18 months post bariatric surgery by effective contraception. Regular and frequent laboratory test to assess levels of iron, haemoglobin, ferritin, transferrin, calcium, homocysteine, cobalamin and retinol should be done for adequate supplementation. Regular ultrasound for assessment of fetal growth is mandatory in these patients. Therefore special care during pregnancy is needed in these patients for healthy outcome.

REFERENCES

- [1] Sturm R. Increases in morbid obesity in the USA: 2000-2005. *Public Health*. 2007;121(7):492-96.
- [2] Wang Y, Chen HJ, Shaikh S, Mathur P. Is obesity becoming a public health problem in India? Examine the shift from under- to overnutrition problems over time. *Obesity Reviews*. 2009;10:456-74.
- [3] Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults—The Evidence Report. National Institutes of Health. *Obes Res*. 1998;6 (Suppl 2):51-209S.
- [4] Castro L, Avina R. Maternal obesity and pregnancy outcome. *Curr Opin Obstet Gynecol*. 2002;14:601-06.
- [5] Guelinckx I, Devlieger R, Beckera K, Vansant G. Maternal obesity: Pregnancy Complications, Gestational Weight gain and Nutrition. *Obes Rev*. 2008;9:140-50.
- [6] Metwally M, Ong KJ, Ledger WL, Li TC. Does high body mass index increase the risk of miscarriage after spontaneous and assisted conception? A meta-analysis of the evidence. *Fertil Steril*. 2008;90:714-26.
- [7] Bhattacharya S, Campbell DM, Liston WA, Bhattacharya S. Effect of Body Mass Index on pregnancy outcomes in nulliparous women delivering singleton babies. *BMC Public Health*. 2007;7:168.
- [8] Stothard KJ, Tennant PW, Bell R, Rankin J. Maternal overweight and obesity and the risk of congenital anomalies: a systematic review and meta-analysis. *JAMA*. 2009;301:636-50.
- [9] Ecker JL, Greenberg JA, Norwitz ER, Nadel AS, Repke JT. Birth weight as a predictor of brachial plexus injury. *Obstet Gynecol*. 1997;89:643-47.
- [10] Whitaker RC, Wright JA, Pepe MS, Seidel D, Dietz WH. Predicting obesity in young adulthood from childhood and parental obesity. *N Engl J Med*. 1997;37:869-73.
- [11] Rasmussen S, Albrechtsen S, Irgens LM, Dalaker, Maartmann-Moe H, Vlatkovic L, et al. Risk factors for unexplained antepartum fetal death in Norway 1967-1998. *Early Hum Dev*. 2003;71:39-52.
- [12] Pirkola J, Pouta A, Bloigu A, Hartikainen AL, Laitinen J, Jarvelin MR, et al. Risks of overweight and abdominal obesity at age 16 years associated with prenatal

exposures to maternal prepregnancy overweight and gestational diabetes mellitus. *Diabetes Care*. 2010;33:1115-21.

- [13] Catalano PM. Management of obesity in pregnancy. *Obstet Gynecol*. 2007;109:419-33.
- [14] Sjostrom L, Lindroos AK, Peltonen M, Torgerson J, Bouchard C, Carlsson B, et al. Lifestyle, diabetes, and cardiovascular risk factors 10 years after bariatric surgery. *N Engl J Med*. 2004;351(26):2683-93.
- [15] Li Z, Maglione M, Tu W, Mojica W, Arterburn D, Shugarman LR, et al. Meta-analysis: pharmacologic treatment of obesity. *Ann Intern Med*. 2005;142:532-46.
- [16] Gardner CD, Kiazand A, Alhassan S, Kim S, Stafford RS, Balise RR, et al. Comparison of the Atkins, Zone, Ornish, and LEARN diets for change in weight and related risk factors among overweight premenopausal women: the A TO Z Weight Loss Study: a randomized trial. *JAMA*. 2007;297:969-77.
- [17] Maggard MA, Shugarman LR, Suttorp M, Maglione M, Sugerman HJ, Livingston EH, et al. Meta-analysis: surgical treatment of obesity. *Ann Intern Med*. 2005;142(7):547-59.
- [18] Santry HP, Gillen DL, Lauderdale DS. Trends in bariatric surgical procedures. *JAMA*. 2005;294:1909-17.
- [19] Schilling PL, Davis MM, Albanese CT, Dutta S, Morton J. National trends in adolescent bariatric surgical procedures and implications for surgical centers of excellence. *J Am Coll Surg*. 2008;206:1-12.
- [20] Kular KS, Manchanda N, Rutledge R. A 6-year experience with 1,054 mini-gastric bypasses-first study from Indian subcontinent. *Obes Surg*. 2014;24(9):1430-35.
- [21] Raj PP, Kumaravel R, Chandramalteeswaran C, Vaithiswaran V, Palanivelu C. Laparoscopic duodenojejunal bypass with sleeve gastrectomy: preliminary results of a prospective series from India. *Surg Endosc*. 2012;26:688-92.
- [22] Toolabi K, Golzarand M, Farid R. Laparoscopic adjustable gastric banding: efficacy and consequences over a 13-year period. *Am J Surg*. 2015;31. doi:10.1016/j.amjsurg.2015.05.021.
- [23] Bilenka B, Ben-Shlomo I, Cozacov C, Gold CH, Zohar S. Fertility, miscarriage and pregnancy after vertical banded gastroplasty operation for morbid obesity. *Acta Obstet Gynecol Scand*. 1995;74:42-44.
- [24] Mancini MC. Bariatric surgery--an update for the endocrinologist. *Arg Bras Endocrinol Metabol*. 2014;58:875-88.
- [25] Weintraub A, Levy A, Levy I, Wiznitzer A, Mazor M, Sheiner E. Downsizing gestational complications: pregnancy outcome before and after bariatric surgery [abstract]. *Am J Obstet Gynecol*. 2007;197:S186.
- [26] Sheiner E, Levy A, Silverberg D, Menes T, Levy I, Katz M, et al. Pregnancy after bariatric surgery is not associated with adverse perinatal outcome. *Am J Obstet Gynecol*. 2004;190:1335-40.
- [27] Ducarme G, Revaux A, Rodrigues A, Aissaoui F, Pharisien I, Uzan M. Obstetric outcome following laparoscopic adjustable gastric banding. *Int J Gynaecol Obstet*. 2007;98:244-47.
- [28] Wax JR, Wolff R, Cobean R, Pinette MG, Blackstone J, Cartin A. Intussusception complicating pregnancy following laparoscopic Roux-en-Y gastric bypass. *Obes Surg*. 2007;17:977-79.
- [29] Patel JA, Patel NA, Thomas RL, Nelms JK, Colella JJ. Pregnancy outcomes after laparoscopic Roux-en-Y gastric bypass. *Surg Obes Relat Dis*. 2008;4:39-45.
- [30] Dixon JB, Dixon ME, O'Brien PE. Birth outcomes in obese women after laparoscopic adjustable gastric banding. *Obstet Gynecol*. 2005;106:965-72.
- [31] Friedman D, Cuneo S, Valenzano M, Marinari GM, Adami GF, Gianetta E, et al. Pregnancies in an 18-year follow-up after biliopancreatic diversion. *Obes Surg*. 1995;5:308-13.
- [32] Weiss HG, Nehoda H, Labeck B, Hourmont K, Marth C, Aigner F. Pregnancies after adjustable gastric banding. *Obes Surg*. 2001;11:303-06.
- [33] Martin LF, Finigan KM, Nolan TE. Pregnancy after adjustable gastric banding. *Obstet Gynecol*. 2000;95:927-30.
- [34] Dao T, Kuhn J, Ehmer D, Fisher T, McCarty T. Pregnancy outcomes after gastric-bypass surgery. *Am J Surg*. 2006;192:762-66.
- [35] Gadgil MD, Chang HY, Richards TM, Gudzone KA, Huizinga MM, Clark JM, et al. Laboratory testing for and diagnosis of nutritional deficiencies in pregnancy before and after bariatric surgery. *J Womens Health (Larchmt)*. 2014;23:129-37.
- [36] Kakarla N, Dailey C, Marino T, Shikora SA, Chelmow D. Pregnancy after gastric bypass surgery and internal hernia formation. *Obstet Gynecol*. 2005;105:1195-98.
- [37] Marceau P, Kaufman D, Biron S, Hould FS, Lebel S, Marceau S, et al. Outcome of pregnancies after biliopancreatic diversion. *Obes Surg*. 2004;14:318-24.
- [38] Martin L, Chavez GF, Adams MJ, Mason EE, Hanson JE, Currier RW. Gastric bypass surgery as maternal risk factor for neural tube defects. *Lancet*. 1988;1(8586):640-14.
- [39] Haddow JE, Hill LE, Kloza EM, Thanhauser D. Neural tube defects after gastric bypass. *Lancet*. 1986;1(8493):1330.
- [40] Shekelle PG, Newberry S, Maglione M, Li Z, Yermilov I, Hilton L, et al. Bariatric surgery in women of reproductive age: special concerns for pregnancy. *Evid Rep Technol Assess (Full Rep)*. 2008;(169):1-51.
- [41] Chang HY, Richards TM, Gudzone KA, Huizinga MM, Clark JM, et al. Laboratory testing for and diagnosis of nutritional deficiencies in pregnancy before and after surgery. *Journal of Women's health*. 2014;23:129-37.
- [42] Ziegler O, Sirveaux MA, Brunaud L, Reibel N, Quilliot D. Medical follow up after bariatric surgery: nutritional and drug issues. General recommendations for the prevention and treatment of nutritional deficiencies. *Diabetes Metab*. 2009;35:544-57.

- [43] Magdaleno R Jr, Pereira BG, Chaim EA, Turato ER. Pregnancy after bariatric surgery: a current view of maternal, obstetrical and perinatal challenges. *Arch Gynecol Obstet.* 2012;285(3):559-66.
- [44] Campbell CD, Ganesh J, Ficioglu C. Two newborns with nutritional vitamin B12 deficiency: challenges in newborn screening for vitamin B12 deficiency. *Haematologica.* 2005;90:45.
- [45] Decker GA, Swain JM, Crowell MD, Scolapio JS. Gastrointestinal and nutritional complications after bariatric surgery. *American Journal of Gastroenterology.* 2007;102(11):2571-80.
- [46] Guelinckx I, Devlieger R, Vansant G. Reproductive outcome after bariatric surgery: a critical review. *Hum Reprod Update.* 2009;15(2):189-201.
- [47] Kaska L, Kobiela J, Abacjew-Chymko A, Chmylko L, Wojanowska-Pindel M, Kobiela P, et al. Nutrition and pregnancy after bariatric surgery. *ISRN Obes.* 2013;2013:492060.
- [48] Johansson K, Cnattingius S, Naslund I, Lagerros YT, Granath F, stephansson O. Outcomes of pregnancy after bariatric surgery. *N Engl J Med.* 2015;372:814-24.

PARTICULARS OF CONTRIBUTORS:

1. Assistant Professor, Department of Obstetrics and Gynaecology, Hamdard Institute of Medical sciences and Research, New Delhi, India.
2. Associate Professor, Department of Obstetrics and Gynaecology, Hamdard Institute of Medical sciences and Research, New Delhi, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Aruna Nigam,
Flat No 6, Type 4 quarters, LHMC Campus, Bangla Sahib Road, New Delhi-110001, India.
E-mail : bprakasharuna@hotmail.com

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Mar 31, 2015**

Date of Peer Review: **Jul 20, 2015**

Date of Acceptance: **Sep 07, 2015**

Date of Publishing: **Nov 01, 2015**