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Review Article

Producing Slimmer Babies for Easier Vaginal Deliveries

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Abstract

Fetal macrosomia commonly makes vaginal delivery hazardous to mothers and their babies. Furthermore it often increases the rate of obstetric intervention and cost of child birth. In addition, it poses a lifelong morbidity due to obesity, hyperlipidemia, diabetes mellitus, hypertension and coronary artery disease to affected babies and may also predispose to a vicious cycle of pre-gravid obesity and macrosomic pregnancies when affected female babies reach reproductive age. The need to spare women and babies of the hazards of the outcome of macrosomic pregnancies and lifelong morbidity states respectively cannot be overemphasized, This article discusses various ways of controlling the known risk factors, inculcating behavioral modification of nutritional habits to individuals and communities using social intervention model of health education as well as proposing the development of specific protection, to women who are predisposed to macrosomic pregnancies.

Keywords: Fetal macrosomia; Slimmer babies; Vaginal delivery; Behavior modification

Introduction

Fetal macrosomia poses difficulties in vaginal delivery because it commonly predisposes to cephalo-pelvic or feto-pelvic disproportion and shoulder dystocia, which are obstetric conditions, which when predicted, often change the outcome of the process of labor from anticipated vaginal delivery to that of obstetric intervention in the form of cesarean sections. Since the prevalence of fetal macrosomia is 3% to 15% [1] and probably higher in some affluent countries, a significant number of women are prone to complications. Although cesarean section expedites deliveries, it is in many instances abused for various reasons including socioeconomic reasons, assurance of a live baby and fear of litigation. However, it is fraught with danger in unskilled hands and the World Health Organization has therefore recommended that cesarean sections should not be resorted to unnecessarily, as there is evidence that Caesarean sections can cause significant complications, disability or death, particularly in settings which lack the facilities to conduct safe surgeries or treat potential complications [2].

Though fetal macrosomia has been defined as birth-weight over 4,000 g irrespective of gestational age or greater than the 90th percentile for gestational age after correcting for neonatal sex and ethnicity [1], there is currently no consensus in the definition among researchers and obstetricians [3]. In a study of 246,659 singleton term births from 363 facilities in 23 low- and middle-income countries, it was concluded that the use of specific bench marks such as 4000 g for countries in Asia or 4500 for countries in North America was more predictive of adverse maternal and fetal outcomes than benchmarks based on percentile birth weights [3]. Specific benchmark varies in different races and countries. The values of 3.25 Kg, 4.06 Kg and 4.5 Kg have been reported as bench marks of birth weight, above which feto maternal morbidity and mortality sharply increases for India, Algeria and United States of America respectively [4].

The consequences of fetal macrosomia include disproportion, which may be cephalo-pelvic disproportion in fetuses presenting with occiput and feto-pelvic disproportions in breech presenting fetuses. Others include shoulder or cervical dystocia, prolonged labor, postpartum hemorrhage, maternal injuries, fetal injuries, birth asphyxia and metabolic syndrome [5]. Severe forms of maternal injuries include third degree tears and obstetric fistulae.

Since normally presenting slimmer babies are unlikely to develop these complications, women will be spared of the consequences of fetal macrosomia if they can prevent the development of macrosomic pregnancies. The babies are also likely to be healthy and devoid of immediate complications such as birth asphyxia, brachial plexus injuries as well as future complications such as cerebral palsy, a lifelong deformity, and metabolic syndrome, a constellation of diseases, comprising of hyperlipidemia, diabetes mellitus, hypertension and coronary artery disease [6]. Furthermore, a macrosomic female baby has the potential of developing obesity, insulin resistance, hyperlipidemia and hypertension making it an independent risk factor for the conception of macrosomic babies in adulthood [7] thereby establishing a vicious cycle.

Giving birth to slimmer babies also reduces the likelihood of obstetric interventions such as cesarean sections and forceps or vacuum extraction, thereby reducing the cost of delivery. Women, who have planned vaginal delivery, have lower rates of morbidity and shorter hospital stay than those who have cesarean sections. In a retrospective study of primiparous women in Canada, the rates of morbidity were 27.3 and 9.0 per 1000 deliveries for cesarean sections and vaginal deliveries respectively in a 14 year period. The women who had planned cesarean sections had increased postpartum risks of cardiac arrest, wound hematoma, hysterectomy, puerperal infection, anesthetic complications, venous thromboembolism, and hemorrhage

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than women who had planned vaginal delivery [8].

In a study in Nigeria, the cesarean section rate in mothers of macrosomic babies was 39%, compared to 18.8% in mothers of normal babies [9]. In another study in Turkey, the cesarean section rate was 37.3% for the mothers of macrosomic babies and 25.3% for mothers of normal babies [10]. When there is a need to resort to operative delivery, extraction of the fetus is much easier in normal babies and fetal injuries are prevented.

The policy of elective cesarean section in suspected cases of fetal macrosomia has not reduced the incidence of brachial plexus injury, which is the main cause of litigation in obstetrics [11,12]. There is therefore a need to prevent macrosomic pregnancies with the aim of facilitating vaginal deliveries and reducing obstetric intervention rates.

Predicting Birth Weight

Ultrasound Scan of the abdomen of the pregnant woman can be used in the estimation of fetal weight with a high degree of accuracy. Fetal weight may be assessed using clinical examination and obstetric ultrasound scan. Clinical prediction is done by measuring symphysio-fundal height. However predictive errors may occur in the presence of transverse lie, hydramnios, twin pregnancy and uterine fibroid. Ultrasound prediction depends on a combination of ultrasound measurements of the biparietal diameter, femur length and abdominal girth. In a comparative study of various methods of fetal weight estimation at term pregnancy, Chauhan et al. [13] found that measurement of symphiso-fundal height and abdominal girth was the best indicator among all other methods assessed followed by Hadlock's formula by ultrasonographic method. Thus the Hadlock's formula remains the most reliable regression method, producing the smallest random errors [14]. Although Ultrasound scan and clinical examination have been said to have equivalent predictive value ,ultrasound has been found to have a significantly better accuracy in fetal weight estimation in overweight pregnant women than clinical examination. However, no statistically significant difference between the two methods has been observed in normal weight pregnant women. It has therefore been suggested, that the clinical method using Leopold's maneuvers might be useful in countries with poor infrastructure and thus poor availability of ultrasound devices [15].

Modifiable Risk Factors of Fetal Macrosomia

Fetal macrosomia is a preventable condition because the risk factors can be controlled. These factors include diabetes mellitus/ gestational diabetes mellitus, pre-gravid obesity and excessive gestational weight gain. The feature common to these risk factors is maternal hyperglycemia, which is involved in the pathophysiology of fetal macrosomia [16].

Pathophysiology of Fetal Macrosomia

The fundamental basis of fetal macrosomia is unregulated maternal hyperglycemia, which may be due to uncontrolled diabetes mellitus or over-nutrition (excess intake of high glycemic index diet including sugary beverages). Persistent maternal hyperglycemia allows high level of glucose to cross the placenta into the fetal compartment, thereby stimulating the fetal pancreas with consequent release of fetal insulin. Increased fetal blood insulin levels facilitate glucose and amino acid entry into fetal tissues, thereby increasing fetal muscle and fat mass. The increase in fetal fat mass is due to insulin enhanced lipogenesis, which is secondary to the esterification of fatty acids by alpha glycerol-phosphate, a product of insulin enhanced glycolysis [17]. Furthermore, there is increased bone growth especially shoulder bones [18]. The increased muscle and fat mass is responsible for the large size and birth weight of the baby while the elongation of the bones especially those of the shoulders is responsible for the shoulder dystocia that very often complicates the delivery of a macrosomic baby.

Methods for Producing Slimmer Babies

Early diagnosis and control of diabetes mellitus

Pre-pregnancy counseling and diagnosis of diabetes mellitus should be done for every woman of reproductive age group. Whenever diagnosis is made, it is necessary to regulate blood glucose prior to the onset of pregnancy or early in pregnancy to avoid hyper-stimulation of fetal pancreas earlier in pregnancy. It has been hypothesized that hyperglycemia sensitizes fetal pancreas in early pregnancy in such a way that diabetic control instituted later fails to have any impact in the control of fetal macrosomia (Pedersen's hypothesis) [19]. However it is necessary to monitor fasting blood glucose every trimester of pregnancy in order to detect onset of gestational diabetes mellitus with the aim of controlling blood glucose and avoiding hyperglycemia throughout the entire duration of pregnancy.

Nutrition Education

Another method of preventing fetal macrosomia is nutrition education, which is aimed at modifying the behavior of women of reproductive age group so that they can understand the pathophysiology of fetal macrosomia, accept and adopt nutritional habits that can prevent fetal macrosomia. Adoption of habits, which ensure that women eat more of low glycemic index diets such as beans, pears, unripe plantain and sweet potatoes and very little of high index glycemic diets such as white bread, white rice, cooked fermented cassava and Irish potatoes [20]. High glycemic index diets should always be eaten along with vegetables and other dietary fibers, which tend to reduce post digestion absorption of glucose [21]. It is also important to avoid sugary beverages such soft drinks and malt drinks during pregnancy and when women are attempting to get pregnant [22]. Since women of reproductive age do not live in isolation in communities, social intervention in form of community education to improve the knowledge of members of the community, so that they can understand and accept the information, and make decision to adopt the nutritional habits that prevent obesity and consequently pre-gravid obesity and excessive gestational weight gain. The opinion leaders in the community should be used as the agents of change. Their knowledge base on the consequences of fetal macrosomia should be improved to the extent that they are motivated to see the prevention of fetal macrosomia as a felt need. Through interaction with them, members of their community can be involved in the nutrition education program. Young women may not see the prevention of pre-gravid obesity as a felt need if the aim is to prevent cesarean section. However, if they are told that they will look more beautiful and their off springs will be very healthy, they are more likely to modify their behavior and avoid nutritional risk factors of obesity [23]. In a study of healthy pregnant women, a high glycemic index diet was associated with greater weight at term than was a nutrient-balanced, low glycemic index diet. The quantity of low glycemic index diet must be limited in order to prevent obesity [24]. Gestational weight gain should be minimized according to the guidelines instituted by the Institute of Medicine, so that women with

Table 1: Institute of Medicine (IOM) guidelines for recommended gestational weight gain based on pre-pregnancy body mass index.

	Gestational weight gain (kg/wk)		
Body Mass Index	**Low**	**Normal**	**Excessive**
Normal weight (18.5-24.9 kg/m^2)	<0.35	0.35-0.50	>0.50
Overweight (25.0-29.9 kg/m^2)	<0.23	0.23-0.33	>0.33
Obese (≥ 30.0 kg/m^2)	<0.17	0.17-0.27	>0.27

higher weights have lower gestational weight gain than women with lower weights (Table 1) [25].

Specific Protection: Scientific Prospects

Specific protection of susceptible women including diabetics, obese women and over-nourished women, who habitually indulge in excessive ingestion of sugary beverages and high glycemic index diets, could be a possibility in the future. This may become available in form of food fortification or food supplementation with substances believed to decrease maternal and fetal insulin levels in the first trimester of pregnancy. One such substance may be caryophyllene, which has been suggested as a probable active ingredient in alligator pepper (*Zingiberacea aframomummelegueta*) [26] and *cannabis sativa.* Beta caryophylline is an approved food additive in U.S.A. [27,28].

Intra-peritoneally injected low doses of the crude extract of alligator pepper during the first trimester has been found to reduce litter weight of pregnant Sprague Dawley rats, without affecting morphology, genetic or reproductive capability of the off-springs of the rats in the experimental group as they were apparently normal and were able to reproduce effectively in a follow up study [29]. Intraperitoneally injected crude extract of alligator pepper has also been found to reduce litter weight in Alloxan induced diabetic Sprague Dawley rats [30] and high glycemic index diet fed Sprague Dawley rats [31]. In effect, caryophyllene, the probable active ingredient of alligator pepper could be a vaccine that can be used for the specific protection of susceptible women against fetal macrosomia.

Physiological basis of specific protection against fetal macrosomia

Caryophyllene is believed to reduce fetal weight by lipo-oxidation since the observed first trimester insulin lowering property of crude extract of alligator pepper causes dis-inhibition of triglyceride lipase and enhances lipo-oxidation. Furthermore, Caryophyllene causes the activation of type 2 cannabinol receptor (CB2R) by a selective agonist thereby promoting lipid oxidation through a signaling/transcriptional pathway [32].

Conclusion

Large babies can result in hazardous deliveries. There is therefore a need to control birth weight especially in mothers predisposed to macosomic pregnancies. Pre-pregnancy counseling of women of reproductive age group on the need to accept and adopt healthy nutritional habits is necessary in order to prevent pre-gravid obesity. All women of reproductive age group should be screened before and during pregnancy so that adequate control and normalization of maternal blood glucose is achievable throughout pregnancy. In the future, it might be possible to develop specific protection against fetal macrosomia in susceptible women using vaccine, food fortification or food supplementation, if it is possible to extract the active ingredient in alligator pepper, which has been found in several studies to reduce litter weight in Sprague Dawley rats. However, all suspected cases of fetal macroosomia should be referred to centers with Essential Obstetric Care for adequate management.

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