

Excess of amniotic fluid: pathophysiology, correlated diseases and clinical management

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Abstract. The evaluation of amniotic fluid volume represents, together with the evaluation of fetal growth, one of the most important indicators of fetal wellbeing. Amniotic fluid is produced by fetal urines with small aliquots from fetal membranes and lung fluids. The main determinant of its turnover is fetal swallowing together with a small absorption through fetal skin and membranes. The pathologic conditions that lead to an excess of amniotic fluid are represented by excessive production or by a reduction of the physiologic turnover. The most frequent cause is gestational diabetes. This complication can be diagnosed in 2-3% of pregnancies, as a result of increased insulin resistance, most frequently found in association with risk factors such as high maternal BMI. Placental hormones, such as HPL, act indeed to increase insulin resistance and can therefore lead to post-prandial hyperglycemia in predisposed mothers. Maternal hyperglycemia leads in turn to fetal hyperglycemia and fetal hyperinsulinemia. Increased amniotic fluid volume is not a constant feature, being associated with the most severe cases, but its evaluation is very useful in the clinical management. The resulting increase in uterine volume, also related to accelerated fetal growth, is a potential cause of premature delivery, a severe complication also considering the delay in fetal lung maturation observed with fetal hyperinsulinemia. The evaluation of the degree of polyhydramnios has to be pursued by ultrasound. Precise diagnostic steps must be followed in order to rule out other potentially associated causes. Amongst these, malformations of the intestinal tract, such as esophageal atresia, that are associated with decreased or absent fetal swallowing, must be considered. The clinical workout must therefore include an ultrasound evaluation of fetal morphology together with an oral glucose tolerance test. The therapeutic approach will be defined according to the definition of the underlying cause. Many cases will benefit from bedrest, tocolysis and induction of lung maturation.

Key words: Amniotic fluid, polyhydramnios, gestational diabetes, accelerated fetal growth

Introduction

During intrauterine life oxygen and nutrients are provided to the fetus from the utero-placental circulation through the placenta in the umbilical circulation. The clinical assessment of fetal growth is the most important parameter for the evaluation of fetal wellbeing. The evaluation of the amount of amniotic fluid is also an important index for the early detection and follow up of fetal pathology during pregnancy. The ex-

cess or reduction of amniotic fluid is associated to a number of conditions in which fetal wellbeing must be strictly evaluated.

Physiology of amniotic fluid

The two primary sources of amniotic fluid are fetal urines and lung fluid, with an additional small contribute due to secretions from the fetal oral-nasal ca-

vities and from the amniotic membranes. The two primary routes of amniotic fluid removal are fetal swallowing and absorption into fetal blood perfusing the fetal surface of the placenta and membranes (1).

Amniotic fluid surrounds the growing conceptus during intrauterine development and provides several important benefits to the fetus such as protection against trauma and infections with its antibacterial properties. In addition, at least moderate amounts of amniotic fluid are required for the fetal musculoskeletal system to develop normally, for gastrointestinal system development and for the fetal lungs to mature as needed in preparation for breathing. Hence, it is not surprising that oligohydramnios and polyhydramnios are associated with increased rates of perinatal morbidity and mortality.

Pathophysiology and diagnosis of polyhydramnios

Quantitatively, polyhydramnios is diagnosed whenever the amniotic fluid volume exceeds 2000 ml (2). Actually the diagnosis of polyhydramnios can be suspected based on clinical impression and confirmed by sonographic estimation. The most widely applied ultrasonographic method to measure the fluid volume is the four-quadrant fluid index that has become a standard procedure at the time of routine ultrasound examination (3).

On the basis of this measurement, polyhydramnios is defined as an amniotic fluid index (AFI) is in excess of 25 cm (4). Under these circumstances, polyhydramnios in the general population ranges from 0.2% to 1.6% (5).

The possible factors that lead to a pathologic accumulation of amniotic fluid can be represented by excessive production and/or utilization.

Excessive production, i.e. significant polyhydramnios, is frequently associated with fetal malformations, mostly of the central nervous system or gastrointestinal tract. Increased transudation of fluid from exposed cerebral tissues into the amniotic cavity may be an etiologic factor in case of anencephaly and spina bifida.

Reduced utilization can be found with impaired fetal swallowing, for example in case of atresia esophagea, that may result in excess of amniotic fluid volume.

Fetal structural malformations and chromosomal and genetic abnormalities are also associated with polyhydramnios, but the mechanism is poorly understood. The incidence of chromosomal abnormalities in the presence of polyhydramnios is as high as 35%, particularly when associated with severe polyhydramnios and intrauterine growth restriction. The most common chromosomal abnormalities involve the trisomies 13, 18 and 21 (6).

Metabolic fetomaternal alterations may also be an important cause of polyhydramnios. In gestational diabetes, a disease that complicates 3-5% of pregnant women, polyhydramnios is found to be 30 times more frequent than in non diabetic pregnancies (7). This condition is due to an unbalancing of the anti-insular effect of maternal and placental hormones (specifically, human placental lactogen, estrogens, progesterone, prolactin, cortisol and probably inhibin). Women predisposed to developing increased insulin resistance are at increased risk for gestational diabetes. Risk factors are represented by high body mass index, age over 35, previous gestational diabetes and familiarity. The resultant maternal hyperglycemia of those cases leads to fetal hyperglycemia and hyperinsulinemia, as described by Pedersen (8). Fetal hyperinsulinemia results in enhanced glycogen synthesis, lipogenesis, increased protein synthesis and thus fetal organomegaly and fat deposition.

The etiology of polyhydramnios in diabetes is probably related to fetal polyuria due to increased osmotic diuresis secondary to fetal hyperglycemia. Polyhydramnios is in good agreement with the degree of maternal metabolic control. Polyhydramnios complicating diabetes in pregnancy is associated with higher perinatal mortality and morbidity rates than diabetes with normal amniotic fluid. For this reason, the evaluation of amniotic fluid represents an important parameter, together with fetal growth assessment and maternal glycemic control, to evaluate the metabolic control of gestational diabetic women and to select high risk patients.

Clinical relevance

The management of patients with polyhydramnios must begin with an accurate ultrasonographic

screening, focusing on the more commonly identified malformations associated with polyhydramnios (anencephaly, hydrocephaly, encephalocele, gastro-schisis, omphalocele, esophageal atresia, duodenal atresia, chilotorax). In the absence of sonographic abnormalities, the evaluation must include testing for gestational diabetes (Oral Glucose Tolerance Test: OGTT), fetal infections (toxoplasmosis, cytomegalovirus), Rh immunization and hemoglobinopathies.

It has been generally accepted that polyhydramnios is associated with an increased frequency of preterm labor and preterm premature rupture of the membranes (9). This is particularly important in accounting for the increased rates of perinatal mortality and morbidity. Moreover, the degree of polyhydramnios is directly associated with the perinatal mortality rate. The association between preterm delivery and gestational diabetes is of particular interest, since fetal lung maturation is retarded by the effect of hyperinsulinemia. Therefore prophylactic measures should be adopted to avoid preterm delivery in polyhydramnios associated with diabetes. The most frequent maternal complications associated with an excess of amniotic fluid are placental abruption, uterine dysfunction and postpartum hemorrhage. Prolapse of the umbilical cord during membrane rupture and placental abruption as the uterus rapidly decreases in size, add further to bad outcomes. Abnormal presentation and operative intervention are also common.

Minor degrees of polyhydramnios rarely require treatment. On the contrary, acute polyhydramnios with severe dyspnea and abdominal pain may benefit by reduction of amniotic volume by serial amniocentesis eventually associated with maternal administration of prostaglandin synthetase inhibitors. These

treatments are however associated with some risk for the mother and the fetus. In this situation ultrasound is useful for monitoring attempts to reduce amniotic fluid index.

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