Anthropometric Assessment of Infants of Diabetic Mothers

Thesis Submitted for Partial Fulfilment of the Master Degree in Pediatrics

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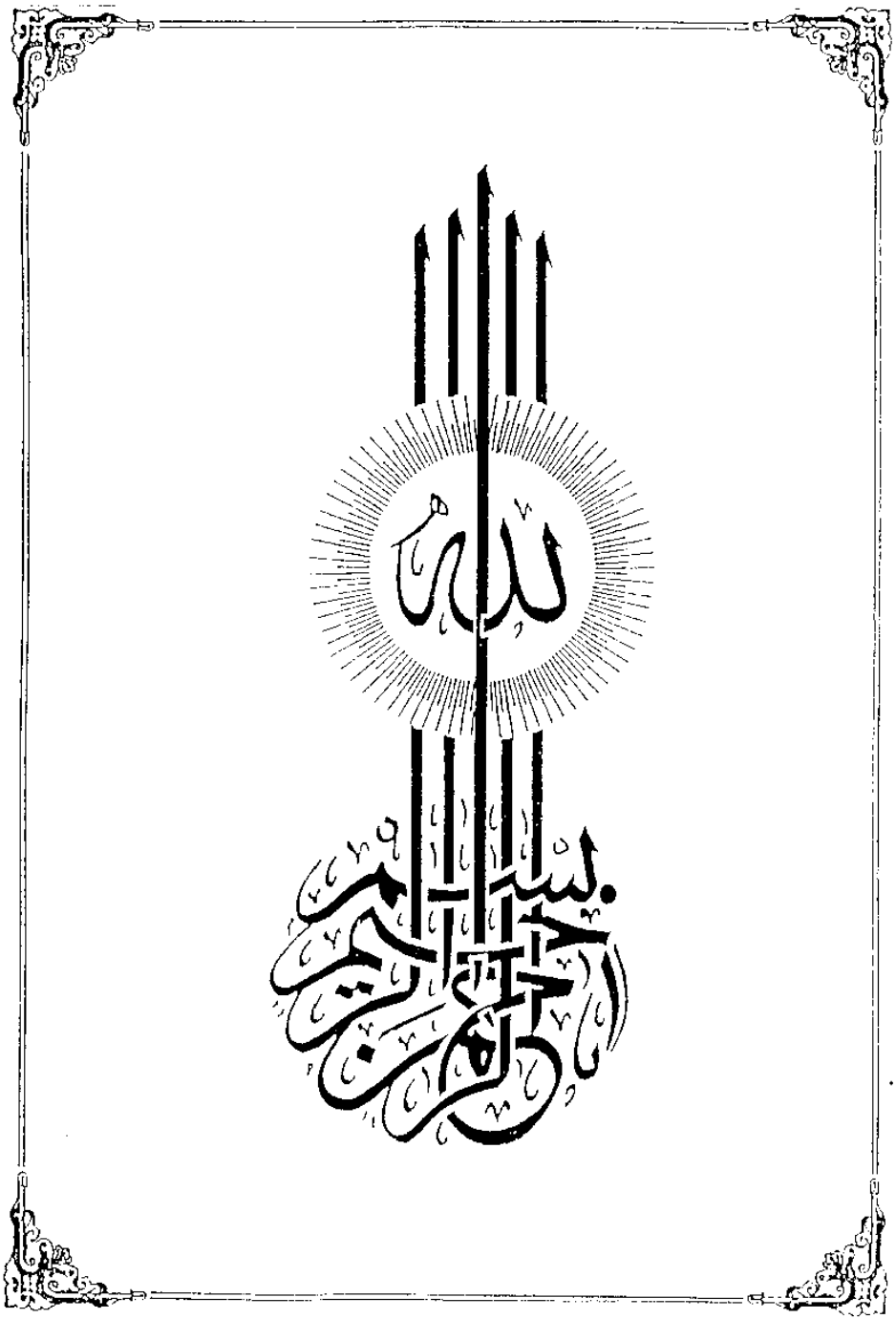

Abbreviation

AGA	Appropriate for Gestational Age
BMI	Body Mass Index
cm	centimeter
CS	Cesarean Section
DM	Diabetes Mellitus
GD	Gestational Diabetes
gm	gram
HbA1c	Glycosylated Hemoglobin
HCM	Hypertrophic Cardiomyopathy.
IDDM	Insulin Dependent Diabetes Mellitus
IDGDM	Insulin Dependent Gestational Diabetes Mellitus
IDM	Infant of Diabetic Mother
IUGR	Intrauterine Growth Retardation
Kg	Kilogram
LGA	Large for Gestational Age
MAC	Mid Arm Circumference
MAC/HC	Mid Arm Circumference / Head Circumference ratio
mm	millimeter
NIDDM	Non - Insulin Dependent Diabetes Mellitus
No.	Number
NVD	Normal Vaginal Delivery
RDS	Respiratory Distress Syndrome
SD	Standard Deviation
Wt	Weight

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The infant of diabetic mother is classically macrosomic, with all organs weights at the top end of normal, due to growth factor effect of insulin in utero **(Black, 1991)**.

Recently, attention has been given to subdividing IDMs with macrosomia into those whose birth weight was proportional to length and those whose birth weight was disproportionately high relative to length, in an attempt to identify those IDMs who may have an increased risk of neonatal morbidity **(Ballard et al., 1993)**.

An increase in total body fat in IDMs has been supported by direct measurements as well as assessment of subcutaneous stores using skin fold thickness measurements. The amount of subcutaneous fat present in the IDMs may be an indication of the quality of diabetic control achieved during gestation **(Whitelow et al., 1977)**.

Aim of the Work

The purpose of this study is to assess the anthropometric measurements in infants of diabetic mothers as compared to infants of non-diabetic mothers, and see impact of control of diabetes during pregnancy on outcome.

Review of Literature

I. Diabetes Mellitus and Pregnancy

Introduction

The deleterious effects of maternal diabetes mellitus on development and outcome of the fetus and newborn have long been recognized, and the opportunity to improve this outcome has been one of the first challenges to be met by a co-ordinate perinatal - neonatal approach to management **(Ballard, 1991).** Diabetes mellitus is not only a disturbance of glucose metabolism, Since insulin has multiple effects on metabolism of proteins and fatty acids. The control of DM with insulin has lead to the survival of increasing numbers of diabetic women. Their infants share certain distinctive morphologic characteristics, including large size, macrosomia, and high morbidity risks **(Swenne, 1988).**

Metabolic Disturbances and Pathophysiology

Normal Pregnancy

The maternal glucose-insulin balance that occurs during normal pregnancy favors hyperglycemia because, despite some degree of hyperinsulinism secondary to islet cell hyperplasia, pregnancy is apparently associated with insulin resistance. This resistance is thought to be related to changes in other maternal hormones, such as human placental lactogen, progesterone, cortisol, and possibly prolactin **(Gabbe, 1985).** In addition, disposal of glucose after carbohydrate

intake appears to be impaired, causing somewhat higher maternal glucose levels. Glucagon is suppressed by glucose during pregnancy, lipid metabolism is also altered, with more glucose being converted to triglyceride in pregnant, compared with non pregnant women. The effect of this process is to conserve calories and enhance fat deposition **(Hunter, 1989)**.

Evaluation of the risk for the fetus can be done best by considering that there are two conditions in which pregnancies may be complicated by diabetes mellitus:

1. Diabetes existing before pregnancy.
2. Gestational diabetes.

The risk assessment of **White (1949)**, as modified by **Hare, in 1989** is presented in (**Table 1**).

Gestational Diabetes

Depending upon the diagnostic criteria used, approximately 3% - 12% of previously non-diabetic pregnant women develop some glucose intolerance during the second half of gestation. The mechanism is not fully understood, however, follow up studies indicate that about 40- to 60% of overweight women with glucose intolerance during pregnancy develop overt diabetes within the subsequent 10 to 20 years **(Ballard, 1991)**.

Table 1

White's classification of maternal diabetes (revised)

Gestational diabetes (GD):	Diabetes not known to be present before pregnancy Abnormal glucose tolerance test in pregnancy
GD diet:	Euglycemia maintained by diet alone
GD insulin:	Diet alone insufficient; insulin required
Class A:	Chemical diabetes; glucose intolerance prior to pregnancy; treated by diet alone; rarely seen. Prediabetes; history of large babies more than 4 Kg or unexplained stillbirths after 28 weeks.
Class B:	Insulin-dependent; onset after 20 years of age duration less than 10 years
Class C:	C1: Onset at 10 to 19 years of age C2: Duration 10 to 19 years.
Class D:	D1: Onset before 10 years of age D2: Duration 20 years D3: Calcification of vessels of the leg (**macro vascular disease**) D4: Benign retinopathy (**microvascular disease**) D5: Hypertension (**not pre-eclampsia**)
Class F:	Nephropathy with over 500 mg per day of proteinuria
Class R:	Proliferative retinopathy or vitreous hemorrhage
Class RF:	Criteria for both classes R and F Coexist
Class G:	Many reproductive failures
Class H:	Clinical evidence of arteriosclerotic heart disease
Class T:	Prior renal transplantation.

Note: All classes below A require insulin. Classes R, F, RF, H and T have no criteria for age of onset or duration of disease but usually occur in long term diabetes (Hare, 1989)

Diabetes Mellitus During Pregnancy

The general insulin resistance of pregnancy makes hyperglycemia in women with true DM very difficult to control, particularly after the first trimester. It is not unusual for a diabetic women's insulin requirement to increase up to three-fold during pregnancy; therefore, the development of ketoacidosis may both be more rapid and occur at relatively low blood glucose **(Stronge et al., 1986)**. Ketoacidosis is, by far, the most serious metabolic disturbance that can affect the fetus, with a mortality rate of 50 percent in fetuses of women who have had a serious episodes of ketoacidosis. Women with DM are also more likely to develop hypoglycemia during pregnancy; this is attributed to two factors:

1. Increased placental fetal utilization of glucose.
2. Limitation of hepatic gluconeogenesis due to relative lack of alanine, a major substrate.

In hypoglycemia, the risk is primarily to the mother, since the fetus appears to be protected at the mother's expense **(Menon and Sperling, 1988)**.

Maternal-Fetal Problems

Women with poor diabetic control in pregnancy have a significantly increased incidence of spontaneous abortions, there is no increase in the spontaneous abortion rate in early pregnancy in well-controlled diabetic pregnancies as compared with non-diabetic pregnancies **(Sutherland and Pritchard, 1986)**.

In the third trimester, a major problem is sudden, unexpected fetal death. Such deaths are sometimes associated with ketoacidosis, pre-eclampsia, or maternal vascular disease of the decidua and myometrium, but many are unexplained. The incidence of this problem has decreased during the past 10 years with the use of tests of fetal well being, but it still occurs occasionally **(Hare, 1989).**

The risk of complications is minimal in gestational diabetes, although macrosomia and neonatal hypoglycemia are sometimes seen. The most difficult maternal, fetal and neonatal problems occur in women with renal, cardiac, or retinal disease. Class F (**renal**) is associated with the necessity for early delivery, Class H (**cardiac**) is associated with maternal death, **Retinopathy** may progress during pregnancy (Hare, 1988). Fetal macrosomia and enlargement of the cord and placenta may be seen in gestational diabetes and in class A, B, C and some D diabetic pregnancies **(Kitzmiller, et al., 1982).**

In diabetic women with vascular disease (**especially class F**), there is an increased risk of in utero growth retardation, which is associated with a small infarcted placenta, decreased utero placental perfusion, decreased urinary estriol, and increased incidence of in utero fetal death, fetal distress, neonatal complications and poor outcome. Hypertension in pregnancy is the largest cause of premature delivery and thus of respiratory distress syndrome **(Kitzmiller et al., 1981).**

The Infant of Diabetic Mothers and Associated Problems

Pathophysiology

The probable pathogenic sequence of maternal hyperglycemia, is that it causes fetal hyperglycemia, and the fetal pancreatic response leads to fetal hyperinsulinemia; fetal hyperinsulinemia and hyperglycemia then causes increased hepatic glucose uptake and glycogen synthesis, accelerated lipogenesis, and augmented protein synthesis (***refer to figure 1***) **(Behrman and Kliegman, 1992).** Pathologic correlates include macrosomia, increased adipose tissue, increased weight of placenta and different organs except the brain. Hyperinsulinemia stimulates production of erythropoietin that results in polycythemia **(Cowett, 1983).**

I- Macrosomia

Introduction

Macrosomia, is defined as a birth weight over the 90th percentile using a population specific growth curves, or over 4000 gm **(Langer et al., 1989).** According to these definitions, macrosomia has been observed in as many as 50% of pregnancies complicated by gestational diabetes mellitus and 40% of insulin dependant diabetic mothers **(Miller and spellacy, 1985).** The infant of diabetic and gestational diabetic mothers often bear a surprising resemblance to each other. They tend to be large and plump due to increased body fat and enlarged viscera, with puffy, plethoric facies resembling those of patients who have been receiving a corticosteroid **(Behrman and Kliegman, 1992).**