PERINATAL OUTCOME IN RELATION TO MATERNAL GLYCEMIC CONTROL IN GESTATIONAL DIABETES MELLITUS

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CERTIFICATE

This is to certify that the dissertation entitled **" PERINATAL OUTCOME IN RELATION TO MATERNAL GLYCEMIC CONTROL IN GESTATIONAL DIABETES MELLITUS"** is a bonafide work done by **DR. V. SUJA** in the Institute of Social Obstetrics, Govt. Kasturba Gandhi hospital (Madras Medical College) Triplicane, Chennai in partial fulfillment of the university rules and regulations for award of MD degree in Obstetrics and Gynaecology under my guidance and supervision during the academic year 2011 to 2014.

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DECLARATION

I solemnly declare that this dissertation entitled **" PERINATAL OUTCOME IN RELATION TO MATERNAL GLYCEMIC CONTROL IN GESTATIONAL DIABETES MELLITUS"** was done by me at The Institute Of Social Obstetrics, Govt. Kasturba Gandhi Hospital, Madras Medical College during 2011-2014 under the guidance and supervision of Prof.Dr.Padmini MD,DGO. This dissertation is submitted to the Tamil Nadu Dr. M.G.R. Medical University towards the partial fulfillment of requirements for the award of M.D. Degree in Obstetrics and Gynaecology (Branch-II).

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CONTENTS

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Dear V.Suja

The Institutional Ethics committee of Madras Medical College, reviewed and discussed your application for approval of the proposal entitled "Perinantal outcome in relation to meternal glycemic control in Gestational Diabetes Mellitus" No.04072013.

The following members of Ethics Committee were present in the meeting held on 02.07.2013 conducted at Madras Medical College, Chennai -3.

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We approve the proposal to be conducted in its presented form.

Sd/ Chairman & Other Members

The Institutional Ethics Committee expects to be informed about the progress of the study, and SAE occurring in the course of the study, any changes in the protocol and patients information / informed consent and asks to be provided a copy of the final report.

R Nadini 12/7/13
Member Secretary, Ethics Committee

Introduction

INTRODUCTION

Pregnancy is a condition where the metabolic adaptations occur to accommodate rapidly growing tissue transplant, conceptus. Placenta, new organ arises de novo during the pregnancy, develops and matures till it is expelled at the completion of gestation. The conceptus for its own normal development causes alteration in the maternal metabolism characterized by hyperinsulinemia, low fasting and postprandial blood sugar levels when compared to the non pregnant state. The placenta facilitates embryogenesis, growth maturation and synthesis of peptide and steroid hormones and transport of fuel to the fetus from the mother. Thus metabolism in normal pregnancy is characterized by facilitated action of insulin in the first half of pregnancy and diabetogenic stress in the second half of pregnancy.

Gestational diabetes mellitus is defined as carbohydrate intolerance of variable severity resulting in hyperglycemia with the onset or first recognition during pregnancy. This is applicable regardless of the patient whether they are on insulin or only on diet modification.

GDM represents an unidentified pre existing disease or because of the stress in pregnancy leading to a compensated metabolic abnormality which is unmasked or a direct consequence leading to altered maternal metabolism in pregnancy. Thus importance of GDM lies in fact that it is associated with

higher risk of type 2 diabetes in their later life in future. Most women control blood sugar with medical nutritional therapy and moderate exercise but who fail to control blood sugar needs anti diabetic medication like insulin.

Gestational diabetes is diagnosed by screening all the pregnant women during the pregnancy because GDM generally have few or no symptoms. High level of glucose in the blood samples is detected inappropriately by the diagnostic test. Depending upon the population studied, 3 to 10% of pregnancies are affected by GDM.

Babies born to mothers with gestational diabetes mellitus have increased risk for macrosomia, hypoglycemia, respiratory distress, still birth, hypocalcemia, shoulder dystocia, seizures, hyperbilirubinemia, intrauterine death, perinatal morbidity. Women with adequate blood glucose control can decrease the risk of adverse neonatal outcomes when gestational diabetes are treated effectively. These offspring are more prone for developing obesity in childhood and type 2 diabetes in their later life.

AIM OF STUDY

AIM OF STUDY:

- To determine the perinatal outcome in relation to maternal fasting and postprandial (2 hours) blood sugar control in gestational diabetes mellitus.
- Perinatal outcomes included are macrosomia, Respiratory distress syndrome, hypoglycemia, seizures, hyperbilirubinemia, NICU admission, Anomaly, IUD, Stillbirth, perinatal injury, perinatal mortality.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Pregnancy is a physiological event in which there is a progressive change in the carbohydrate metabolism in mother. As the pregnancy advances, there is compensatory increase in insulin secretion due to diabetogenic stress and increase in insulin resistance due to placental hormones. When this compensation is inadequate, gestational diabetes develops.

GDM is associated with increased perinatal mortality and morbidity when blood sugar is not under control. So universal screening for the detection of carbohydrate intolerance in pregnancy is recommended. Treatment depends upon the degree of glucose intolerance.

So by early and routine screening for all pregnant mother and treating mothers with GDM can reduce the perinatal mortality and morbidity.

DEFINITION

Gestational diabetes is defined as carbohydrate intolerance of varying severity with the onset or first recognition during pregnancy. This is applicable regardless of the patient whether they are on insulin or not. (American diabetic association). [1]

CLASSIFICATION

Classification aids in the diagnosing the severity of diabetes and to plan the management and to assess the prognosis of the mother and fetus.

Priscilla Whites classification [(2)] on perinatal outcome is based on the diabetes type, age of onset, duration of diabetes and its complications.

It distinguishes GDM [type A] from the overt diabetes. These two groups are divided further based on their associated risk and management. [(3)]

PRISCILLA WHITES CLASSIFICATION

CLASS A:

Type A1:

Abnormal oral glucose tolerance test followed by fasting and 2- hr post prandial blood sugar levels are normal. So blood sugar levels are maintained by dietary modification.

Type A2:

Abnormal OGTT followed by elevated fasting and 2- hr post prandial blood sugar levels. So insulin is needed along with diet modification.

CLASS B: Age of onset $\geq$ 20 Years, short duration < 10 years

CLASS C: Age of onset 10 – 19 years, duration of 10 – 19 years

CLASS D: Age of onset under 10 years, duration > 20 years, background retinopathy

CLASS F: Nephropathy with over 500 mg/day proteinuria

CLASS H: Clinically evident atherosclerotic heart disease

CLASS R: Vitreous hemorrhage or proliferative retinopathy

CLASS RF: Criteria for both class R and F coexists

CLASS T: Prior renal transplant

ACOG CLASSIFICATION OF DIABETES COMPLICATING

PREGNANCY

Class	**Onset**	**Fasting plasma glucose**	**2- hr PPBS**	**Therapy**
A1	Gestational	<105 mg/dl	<120 mg/dl	Diet
A2	Gestational	>105 mg/dl	>120 mg/dl	Insulin
CLASS	**Age of onset**	**Duration**	**Vascular disease**	**Therapy**
B	>20	<10	None	Insulin
C	10 - 19	10 - 19	None	Insulin
D	Before 10	>20	Benign retinopathy	Insulin
F	Any	Any	Nephropathy	Insulin
R	Any	Any	Proliferative retinopathy	Insulin
H	Any	Any	Heart	Insulin

PATHOPHYSIOLOGY

Effects of insulin on glucose uptake and metabolism:

1. Insulin attach to its receptors on cell membrane and causes activation of many protein cascades. 2. Translocation of GLUT-4 transporters to the plasma membrane and causes influx of glucose. 3. Promotes glycogen synthesis, glycolysis and fatty acid synthesis.

The hallmark in pathogenesis of GDM is increased insulin resistance. Pregnancy hormones and other factors bind to insulin receptor and interfere with action of insulin. This interference occurs behind the insulin receptor at the level of cell signaling pathway. Entry of glucose into the cells is promoted by insulin whereas in insulin resistance proper entry of glucose into the cells is prevented. As a result, blood sugar levels are elevated. More insulin is needed to overcome the resistance. So insulin is produced about 1.5 to 2.5 times higher than in normal pregnancy.[4]

The metabolic changes occurring in normal pregnancy are essential for supplying the nutrients to the growing fetus. As pregnancy advances, increased level of human sommatomammotrophin, cortisol , prolactin, progesterone and oestrogen leading to insulin resistance in peripheral tissues. Normally in pregnancy insulin resistance starts in the second trimester and

progresses to the level as that occurs in women with type 2 diabetes who are non pregnant.

The reason is not known why some of the patients are not able to balance the insulin needs and develop gestational diabetes. Reasons are given similar to those in type 2 diabetes mellitus. Autoimmunity, obesity, single gene mutation and other mechanisms.[5]

Glucose travels across the placenta by GLUT3 carriers by the process of facilitated diffusion. Therefore fetus is exposed to high blood glucose level and thus causing increased insulin secretion in the fetus. The growth stimulating effects of insulin leads to excessive growth and macrosomia in the fetus. After birth blood sugar levels are low with high insulin production leading to hypoglycemia. [6]

SCREENING IN PREGNANCY

Need for screening

- Majority of the patients with mild carbohydrate intolerance do not have any signs and symptoms.
- Routine blood and urine tests are not reliable for diagnosing GDM.
- Glucose intolerance in pregnancy leads to significant increase in maternal morbidity and fetal mortality and morbidity.

- So early diagnosis and treatment is essential to prevent mortality and morbidity.

POPULATION TO BE SCREENED

Early screening for glucose intolerance results in the reduction of some complications due to hyperglycemia.[7] Screening done in the third trimester results in delivering big baby in large number of pregnant women despite good control of blood sugar.[8] So early screening is essential.

The ideal time for screening is around 16 weeks of gestation and should be done earlier in the people with high risks.[9] Insulin is detected in fetal pancreas at 9 weeks of gestation. By16th week, pancreatic cell mass increase in the fetus leading to increase in insulin secretion in response to maternal hyperglycemia.[10] This priming of beta cells in fetus accounts for persistence of fetal hyperinsulinemia throughout pregnancy resulting in fetal growth acceleration even when the mother has good blood sugar control in later part of pregnancy.[11]

Therefore screening should be started in first trimester itself to diagnose GDM. Early detection and care result in better outcome of fetus .[12] Pregnant women having normal glucose tolerance in the first trimester should be screened again at 24th – 28th week of gestation and again at 32nd -34th week of gestation if it is normal in second trimester.[13]

Universal screening - It is practiced in high risk population who are more prone to develop type 2 diabetes mellitus.

High risk screening - It is done for the patients with the following risk factors as recommended by ACOG.

Risk factors for screening

- Age > 25 years
- Obesity
- Ethnic group people with a high prevalence for GDM
- History of macrosomia , congenital anomalies in the previous pregnancy, stillbirth, IUD
- Family history of diabetes
- Previous unexplained neonatal death
- History of GDM or PIH in previous pregnancy
- History of recurrent spontaneous early pregnancy loss
- History of recurrent UTI and moniliasis
- History of polyhydramnios in previous pregnancy
- Glycosuria
- History of preterm labor and delivery

35 – 50% of women with GDM will not have any of the above risk factors. If high risk screening methods are used, 35 – 50% of diabetic patients will be

missed.[14] Universal screening detects higher number of cases when compared to selective screening and improving the maternal and fetal prognosis.[15]

ACOG recommends selective screening in some settings and universal screening in high risk groups. In a study done in south India, it was found that when screening is based on historical risk factors alone, 45.4% of the pregnant women remain unscreened. Among the unscreened population, 35% had abnormal glucose tolerance.[16] So American Diabetic Association recommends universal screening for all the patients. Indian women have high prevalence of developing gestational diabetes among the ethnic group in South Asian countries.[17] Indian women have 11 fold increased risk for developing glucose intolerance in pregnancy when compared with Caucasians.[18] So in India screening is recommended for all the pregnant women.

METHODS OF SCREENING

Various screening methods are available to screen gestational diabetes.

1) Glucose challenge test

This test is adopted by O' Sullivan and co-workers as a screening test in 1973. 50 gm of glucose in 200 ml of water was given to the patient irrespective of time of last meal or time of the day. Venous blood was drawn after one hour and the plasma glucose level is estimated. The recommended

threshold is 140 mg/dl for this test. It has sensitivity of 80% and specificity of 90%. The sensitivity is increased to 90% if the cut off is taken as 130 mg/dl.

Therefore 50 gm of glucose tolerance test is the best and reliable screening test for gestational diabetes.[19,20] This test is performed soon after the pregnancy is diagnosed in high risk patients. If the test is negative, repeat again at 24 to 28 weeks of gestation. For the low risk patients it is done between 24 to 28 weeks of gestation. When one hour blood glucose value is more than 200mg/dl, these patients are diagnosed to have GDM directly and followed with fasting and postprandial blood glucose levels.

2) WHO testing

75 gm of glucose load was given and plasma glucose was estimated after 2 hours. Pregnant women need not be in fasting state.[21] When the plasma glucose concentration is more than 140 mg/dl, it is diagnosed as GDM. It is one step procedure and serve both as the screening and diagnostic procedure. This test is simple, feasible and economical.[22]

3) Fasting blood sugar:

Fasting blood sugar in normal pregnant women will be around 70- 90 mg/dl. If it is > 105 mg/dl suggests glucose intolerance. Only 1/3rd of GDM patients will have fasting hyperglycemia. If fasting blood sugar is taken as screening test remaining 2/3rd GDM patients are not diagnosed.[23] When fasting blood sugar level is more than 126mg/dl, the patient is diagnosed as GDM and no need for glucose tolerance test.[1]

4) Post prandial blood sugar

Many patients experience nausea and vomiting with 50 gm of glucose. To improve the compliance and decreasing the side effects various studies are done using various substrates and reported to be adequate substitutes of glucose.

Coustan DR et al [(24)] in 1987 examined test efficacy of a standardized nutrient meal (600 Kcal) given to 20 women with GDM in the early trimester and 50 presumed normal pregnant women in the fasting state. This test shows sensitivity of 75% and specificity of 94%. Similar study was conducted by Ginecol obstet Max in 2002[(25)] and concluded similar results and proved that one hour postprandial test was as effective as 1 hour glucose challenge test.

5) Random plasma glucose estimation

Levin et al found an incidence of 1.5% GDM in patients with high risk using random plasma glucose as a screening test. Nasart et al[(26)] suggested plasma blood glucose estimation is insensitive for identifying GDM with sensitivity of 65%.

6) **Seshiah spot test**

Seshiah et al [(27)] suggest single glucose challenge test with 75 gm of glucose for universal screening and diagnosis. Plasma blood sugar is taken after 2 hours. If the value is $\geq$ 140mg/dl, diagnosed as GDM.

7) Glycosylated HbA1C

HbA1C- a glucose molecule is attached to N- terminal group of beta chain of hemoglobin by a non enzymatic reaction and the attachment depends on concentration of sugar in the blood over a period of time, 3 months. According to the studies [(28)] HbA1C is a poor test to screen for GDM. This test is used in overt diabetes to predict the risk of embryopathy.[(29)]

8) Serum Fructosamine

Fructosamine is associated with glycemic control over the past 1 – 3 weeks. But this test is less sensitive for screening than glucose challenge test.[(30)] Hoffman et al [(31)] suggested that it can be used to detect fetal hyperinsulinemia in women with gestational diabetes. When maternal fructosamine is > 2.6 mmol, it indicates fetal hyerinsulinemia.

9) Urine Sugar Test

In pregnancy renal threshold for glucose excretion is decreased due to increase in glomerular filtration rate of glucose and intermittent tubular defect in absorption of glucose. The specificity of glucosuria is increased by determining significant glucosuria occurring in the second morning fasting urine specimen. Pregnant women with glucosuria are more prone to develop preterm labour (25%) and fetal macrosomia (7%).[(32)]

DIAGNOSIS OF GESTATIONAL DIABETES

One Step Approach – Diagnostic 100 gm oral glucose tolerance test is done with no prior screening test. It is less costly and used in population with higher risk.

Two Step Approach – Initial screening test is done by using 50 gm of oral glucose and one hour plasma glucose concentration is estimated. Diagnostic 100 gm oral glucose tolerance test is performed on those women with elevated blood glucose threshold levels on GCT.

GLUCOSE TOLERANCE TEST:

- 100 gm 3 hour OGTT
- 75 gm 2 hour OGTT – WHO

100 gm Oral Glucose Tolerance Test:

Patient is instructed to have unrestricted diet of >150 gm of carbohydrate per day , unrestricted physical activity for three days before the test and advised to come with overnight fasting of at least 8 hours but not more than 14 hours.[33] The subject remains seated and not to smoke during the test. FBS is taken and patient is advised to drink 100 gm of glucose dissolved in 300 ml of water. Hourly blood sample and urine samples are taken for three hours.

Diagnostic criteria for 100 gm OGTT

Timing of measurement	National diabetes and data groups (in mg/dl)	Carpenter and Coustan (in mg/dl)
Fasting	105	95
1 hour	190	180
2 hours	165	155
3 hours	145	140

The cut off values recommended by Carpenter and Coustan [34] for the extrapolation of blood sugar values was found by O' Sullivan and Mahan [35] for glucose concentrations in plasma. When one value is elevated patient is diagnosed to have impaired glucose tolerance. When two or more values are elevated, patient is diagnosed to have gestational diabetes.

75 gm Oral Glucose Tolerance Test: Sack's recommendation [36]

Time	Mg/dl	Mmol/L
Fasting	95	5.3
One Hour	180	10.0
Two Hours	155	8.6

WHO Diabetes Criteria 2006

Condition	Fasting blood glucose levels (in mg/dl)	2 hours blood glucose levels (in mg/dl)
Normal	<110	<140
75 gm of oral glucose load	>126	>140
Impaired fasting glycemia	110 to 125	<140
Impaired glucose tolerance	<126	≥140 and < 200
Diabetes mellitus	≥126	≥ 200

GDM is diagnosed based on 2 hours 75 gm of oral glucose tolerance test as defined by either WHO criteria or ADA predicts the adverse pregnancy outcomes equally.[37]

Intravenous Glucose Tolerance Test:

In this method 0.5 mg of glucose per kg of ideal body weight is administrated intravenously over 2 minutes. Blood glucose estimation is made

before the injection and at 10 minutes interval for the following hour. These 6 plasma glucose determinations are used to construct a graph. The time taken for blood glucose to fall to half of its value is used to calculate the absolute glucose disappearance rate K.[38]

K value is calculated as

$K = (0.693/ t ½) * 100$

K < 1.5 – abnormal glucose tolerance

The lower limit of normal value of K in first trimester is 1.37, second trimester is 1.18 and third trimester is 1.13. Value below this level is regarded as abnormal.

The oral test is practical for outpatient and it is better in estimating the efficiency of glucose disposal in patients with mild abnormalities in glucose intolerance.

Intravenous glucose tolerance test is useful in patients with gastrointestinal disorders. The K values allow easier method for analysis of glucose tolerance and in most circumstances, it is independent of blood glucose measurements whatever may be the method of test. It is unaffected by variations in gastric emptying and the phenomenon may vary from patient to patient. But intravenous glucose tolerance is more expensive and is non physiological.

For universal screening Seshiah et al [27] suggested that a single glucose challenge test with 75 gm of oral glucose load and when 2 hour plasma venous sample is $\geq$ 140 mg/dl, it is diagnosed to have GDM, $\geq$ 120 and $\leq$ 139 mg/dl diagnosed to have gestational glucose intolerance, $\geq$ 200 mg/dl labeled as overt diabetes. This method is recommended by WHO, because of single step procedure and it is used for both screening as well as diagnostic test. It is simple to perform and it is less costly.

NEONATAL OUTCOME

Fetus of diabetic mothers have wide range of structural and biochemical abnormalities that can be reduced or eliminated by improving the control of blood sugar metabolism.

Macrosomia :

Neonate weighing more than 4.5 kg. In Indian consensus newborn $\geq$ 4 Kg is considered as macrosomia .The reason behind it is fetal hyperinsulinemia. Pedersons hypothesis states that increased maternal blood glucose results in increased fetal blood glucose levels which in turn stimulates the pancreatic fetal cells to produce large amount of insulin which is one of the main growth factor for fetal tissue (Pedersen J, 1967) [39]

Insulin has growth promoting effects by diverting the cell metabolism into anabolic process like lipogenesis , glucogenesis and protein synthesis. It

also influences other endocrine systems to produce other growth factors to stimulate the growth.

There is a continuous association of maternal blood glucose level with increased birth weight of baby. The incidence of macrosomia is decreased when blood sugar is under control.[40] The incidence of shoulder dystocia, birth injuries , neonatal morbidity and asphyxia [41] are increased in macrosomic babies. The risk of birth trauma is more in infants weighing $\geq$ 4.5 kg .[42] Women with elevated fasting and normal postprandial blood sugar values are having the infants at increased risk of macrosomia.

HYPOGLYCEMIA:

Due to endogenous hyperinsulinemia and suppression of endogenous glucose production, the infants are at increased risk of hypoglycemia at 1- 3 hours of birth.[43] Neonatal hypoglycemia is due to hyperplasia of pancreatic beta cells of the fetus and the increased maternal substrate delivery to the fetus as proposed by Pederson et al. [39]After birth, glucose which is supplied continuously from the mother is stopped, so neonate is more prone to develop hypoglycemia due to insufficient delivery of the substrate. Perinatal stress due to release of cathecolamine and depletion of glycogen makes the neonates for further development of hypoglycemia.

50% of babies are asymptomatic. Symptoms of hypoglycemia include irritability, jitteriness, high pitched or weak cry, apathy, poor feeding, hypotonia or seizures. Hypoglycemia which requires intervention may be persisted for one week or longer resulting in increased neonatal intensive care admission and prolonged hospital stay in neonates.[44]

The incidence of hypoglycemia is high in infants whose mothers had a longer duration of diabetes.[45] Hypoglycemia is defined as when blood sugar level is lower than 45 mg/dl but the precise level remain controversial. Thershold levels was proposed by Cornblath et al.[46]

Blood sugar measurements are done

- As soon as after birth
- At any time clinical signs are observed
- Two to three hours after birth and before feeding

Treatment of Hypoglycemia : Immediate 2 ml/kg of IV 10% dextrose infusion is administrated over 5- 10 minutes. Maintenance dose of dextrose is done at an infusion rate of 6- 8 mg/kg/min after the bolus. This is done to prevent rebound hypoglycemia. Blood glucose is measured to properly titrate the dextrose infusion. Once blood sugar levels are stable for 12 hours, dextrose is tapered by 1-2 mg/kg/min and the blood sugar is maintained above 45 mg/dl.

HYPOCALCEMIA:

Defined as serum calcium < 7.5 mg/dl.[47] Asphyxia and prematurity increases the level of cortisol which is a vitamin D antagonist at the intestinal level. Respiratory distress and fetal metabolic acidosis results in shifting of calcium from intracellular to extracellular pool and the reversal occurs during the correction of acidosis causing hypocalcemia. Hypocalcemia is also associated with delay in parathyroid hormone synthesis after birth.

Symptoms includes jitteriness or seizure activity.[48] True hypocalcemia is very rare. In most cases, symptoms caused due to lower level of calcium are mainly due to low blood glucose levels. Hypocalcemia are treated by diluting calcium gluconate to IV solution of dextrose to deliver at a rate of 600-800mg/kg/day.[49] Hypomagnesemia may coexist and may require correction.

RESPIRATORY DISTRESS SYNDROME:

Insulin antagonizes the stimulatory effects of cortisol on fibroblast to induce the synthesis of fibroblast pneumocyte factor. This inhibits phosphotidyl choline production on type 2 pneumocyte cells

- Hyperglycemia
- Decreases the bioavailability of important precursors for phospholipids production and surfactant protein modification.

- Decrease the number of type 2 laminar bodies and alveolar cells.
- Decrease the production of phosphotidyl cholines and phosphtidyl glycerol

RDS presents after the birth shortly and manifested as tachypnea, chest wall retractions, tachycardia, grunting and nasal flaring and may have cyanosis. Most infants with respiratory distress born to GDM mothers were unrelated to surfactant deficiency.[50]

Neonates of the mothers with GDM experiences respiratory distress syndrome even if they are term.[51] Some studies suggested that prenatal steroid administration at 37 to 38 weeks of gestation, 48 hours before elective cesarean section reduces the incidence of transient tachypnea of newborn but this is not commonly done.[52]

Transient tachypnea of the newborn (TTN) is a parenchymal disorder of lung which occurs due to the delayed absorption and clearance of alveolar fluid. Respiratory distress due to TTN is most common in term GDM neonates. TTN is more common in elective cesarean section due to lack of exposure to uterine contractions.[53]

HYPERBILIRUBINEMIA:

It occurs due to the increased production and decreased life span of RBC's with glycosylated cell membranes.[54] Hepatic conjugation of bilirubin may be impaired due to immaturity of liver and deficiency of glucuronyl transferase enzyme. Hyperbilirubinemia is more common in association with polycythemia. It is more common in GDM neonates compared to general population.[49]

Women with normal fasting and elevated postprandial blood sugar values are having the infants at increased risk of hyperbilirubinemia.[55] It is found with increased frequency in macrosomic infants of GDM mothers.[56] Neonates with elevated bilirubin are treated with phototheraphy.[57]

POLYCYTHEMIA:

Polycythemia is defined as peripheral venous hemotocrit is $\geq$ 65 %. It occurs due to hypoxic stimulus by the placental insufficiency and elevated glycohemoglobin.[58] The resultant hyperviscosity may induce congestive cardiac failure and vascular thrombosis. Polycythemia is observed more frequently in infants of GDM mothers. Large for gestational age infants are at greater risk for polycythemia in the early neonatal period.[59] The incidence of polycythemia is 1% - 5%.

INTRAUTERINE DEATH/ STILL BIRTH:

Usually occurs after 36th week of gestation in gestational diabetes.[60,61] Causes are chronic intrauterine hypoxia with acidosis,[62] high fasting blood sugar levels, placental dysfunction and competition for essential nutrients.[63] Women with gestational diabetes are in high risk category for fetal death. Therefore intensive monitoring is essential with the consideration for timed delivery.[64]

EARLY PREGNANCY LOSS:

Early spontaneous pregnancy loss are more common in women with hyperglycemia in periconceptional period and in the first trimester.[65] More common in diabetes complicating pregnancy with poor blood sugar control.

PRETERM BIRTH:

Preterm delivery may be either spontaneous or iatrogenic done for some maternal or fetal indications. It occurs more common in women with type 1 diabetes mellitus. Spontaneous preterm labor or premature rupture of membranes are due to poor blood glucose control.[66] Indicated preterm delivery is due to increased occurrence of preeclampsia.

CONGENITAL ANOMALIES:

The incidence of congenital anomalies is more common in overt diabetes. The abnormalities arise as a consequence of poor glycemic control periconceptionally and during embryogenesis.[67] Incidence of congenital malformation is 5 –10 %.[68]

- Overt diabetes - 10.1 %
- Gestational diabetes - 4.8 %
- Normal population - 2%

ANOMALIES:

CVS:

- Transposition of great arteries

- Atrial septal defect

- Hypoplastic left ventricle

- Ventricular septal defect

- Anomalies of aorta

- Situs inversus

CNS

- Holoprocencephaly
- Encephalocele
- Anencephaly
- Meningomyelocele

SKELETAL & SPINE

- Spina bifida
- Caudal regression syndrome

GENITOURINARY

- Renal agenesis
- Polycystic kidneys
- Ureteral duplication

GASTROINTESTINAL

- Tracheo-oesophageal fistula
- Bowel atresia
- Imperforate anus

The most frequent anomaly involves the heart and CNS. Anomalies are more common in overt diabetes.

MATERNAL OUTCOME:

Complications develop when blood sugar is not under control during pregnancy. Maternal infections are more common in diabetes. Preeclampsia [69] and polyhydramnios are the antenatal complications commonly arise. As a result of this, patients are more prone for preterm delivery.

Approximately 20% of diabetic mothers who deliver vaginally suffer perineal tears. Langer [70] reported the incidence of shoulder dystocia is 0.3% when birth weight of the baby is less than 4.0 kg and increased to 4.9% when the birth weight is more than 4.0 kg. Non diabetic women had 0.5% of shoulder dystocia when compared to diabetic women who had risk of 3.25%.

Complications occurring secondary to a delivery of macrosomic baby [71] are an increased rate of caesarean delivery, shoulder dystocia, birth trauma and postpartum hemorrhage.

MANAGEMENT:

The main aim of treatment is to decrease the risk for both mother and fetus. By good glycemic control, we can reduce the fetal complications and improve the maternal quality of life. Unfortunately more newborns of GDM mothers are admitted in NICU and there is increased induction in labor, with no proven reduction in rates of cesarean section or neonatal mortality.[71] They are still in recent research and controversial.[72]

Specific blood sugar values are used as targets in the treatment that maintain capillary blood sugar levels within the normal range. ACOG guidelines recommends to maintain fasting blood sugar <95 mg/dl, one hour postprandial blood glucose < 140 mg/dl an 2 hour postprandial blood glucose < 120 mg/dl. Guidelines suggested by Jovanovic – Peterson et al[73] are little stricter to maintain FBS < 90 mg/dl and 2 hour PPBS < 120 mg/dl.

MEDICAL NUTRITION THERAPY:

The goal of medical nutrition therapy is to provide adequate calories and nutrients for the mother as well as the fetus, for appropriate maternal weight gain and to achieve the normal blood glucose levels so that starvation and ketosis can be avoided. In the first trimester of pregnancy, usually there will be no increased energy requirements. Whereas in second and third trimester, additional calories of 300 K cal/day are required in pregnant women with normal weight. There is no need for hospitalization in women with GDM for dietary advice and further management if there is good glycemic control.[74]

In women with GDM of normal weight, 30 kcal/kg/day is recommended daily based on their present pregnancy weight. In case of overweight women with GDM of BMI >30 kg/m^2, daily calorie intake is restricted to 25 Kcal/kg/day based on their present pregnant weight. This limitation of calorie restrictions are not usually associated with increased levels of free fatty acids

or ketonuria. However to prevent ketosis adequate measures are taken. More aggressive restriction of calories results in ketosis.[75]

Carbohydrate is divided throughout the day into three snacks and three small to moderate sized meals. When carbohydrates are restricted to 40% of total daily caloric intake, the postprandial blood glucose levels are decreased. Therefore when carbohydrates with low glycemic index are consumed especially in late gestation, it causes reduction in the postprandial blood sugar.

Individualization of medical nutritional therapy is done depending upon the height and weight of the mother as recommended by American diabetic association. Continuous monitoring of blood sugar level is required whether blood sugar level is well controlled with diet. Fasting and postprandial blood sugar levels are measured weekly and then biweekly.

EXERCISE:

Women with GDM are encouraged to have an active life style which should include some exercises. Walking briskly for 30 to 40 minutes per day will improve the glycemic control. Upper limb exercises are recommended if the patient is not permitted for walking. ADA recommends starting or continuing the exercise in GDM women with no medical or obstetrical contraindications.

INSULIN:

It is a pharmacological therapy and it reduces fetal morbidities when added along with medical nutrition therapy. When medical nutrition therapy fails to maintain the self monitored blood glucose at the following levels, insulin is recommended.[76]

- Fasting blood glucose $\geq$ 95 mg/dl.
- 1-hr postprandial blood glucose $\geq$ 140 mg/dl.
- 2-hr postprandial blood glucose $\geq$ 120 mg/dl.

The GDM women need hospitalization to safely titrate dosage and to educate her on self administration of insulin and monitoring the blood glucose levels. To start with, premix insulin 30/70 is better preferred.[8]

- Starting dose of insulin is 4 units before the breakfast
- If blood glucose level is not under control, the dose of insulin is increased to 2 units till 10 units every 4th day.
- If FBS is >90 mg/dl, 6 units prior to breakfast and 4 units prior to dinner is used.
- Blood glucose is repeated and doses of insulin are adjusted according to the blood glucose levels.
- Total dose of insulin is divided per day, 2/3rd of the dose is given in morning and 1/3rd of the dose is given in evening.

- When initial postprandial blood sugar level is high, premix 50/50 is started.
- If 2-hr postprandial blood sugar is > 200 mg/dl at the time of diagnosis, starting dose of insulin is 8 units before breakfast is recommended and the dose is titrated according to the blood sugar level.

When GDM is diagnosed in the third trimester of pregnancy, patient is advised on medical nutrition therapy for one week. When MNT fails, insulin is used. Along with insulin, medical nutrition therapy is recommended. Patients difficult to control blood sugar levels with insulin may be benefited by insulin pump.

Rapidly acting insulin analogs which are available currently are aspart, lispro, and glulisine. Glargine and detemir are the long acting insulin analogs. The insulin analogs are synthesized by recombinant DNA methods.

Lispro, starts its action within 10 to 15 minutes of injection, reaching a higher peak concentration within 30 to 60 minutes and its action lasts for up to 3 to 4 hours. Aspart is also similar to lispro but it takes a slightly longer time to reach its peak concentration of about 40 to 50 minutes and its duration of action is also slightly longer for 3 to 4 hours. Overall, when administrated subcutaneously, rapidly acting insulin analogs have very similar pharmacokinetic and pharmacodynamic actions.

Human regular insulin has its onset of action within 30 to 45 minutes and its effect is prolonged for 2 to 3 hours, whereas rapidly acting insulin analogs have rapid onset of action, reaching their peak concentration earlier and its duration of action is briefer. So it is more similar to physiological dosing of insulin in lowering the post prandial hyperglycemia and avoids the late onset of hypoglycemia.[77]

Glargine takes longer time to start its action (1.5 hours) when compared to ultralente insulin (1 hour) and NPH (0.8 hour). The duration of action for glargine remains longer for 20.5 hours whereas for NPH it about 13.2 hours and ultralent is 19 hours. Currently aspart and lispro are the only insulin analogs which are classified as Category B drugs in pregnancy, which is in the same category risk as like that of regular insulin.

Insulin dose is always individualized and needs to be adjusted according to the blood sugar levels. When the requirements for insulin falls, it may be due to placental insufficiency or fetal jeopardy or may be because of increased utilization of maternal glucose by beta cells of the pancreas in macrosomic fetus.[8]

ORAL HYPOGLYCEMIC AGENTS:

ADA or ACOG does not recommend oral hypoglycemic agents in the pregnancy. The older groups of sulfonylureas such as tolbutamide and

chlorpropamide cross the placenta, stimulating the pancreatic beta cells of fetus to produce increased insulin secretion in the fetus resulting in neonatal hypoglycemia and may aggravate neonatal hyperbilirubinemia by competing for albumin binding sites.

Glyburide is a long acting second generation sulfonyl ureas. It binds to sulphonyl receptor in the beta cells, stimulating the insulin secretion. It is used in patients with some amount of residual functions in beta cells of pancreas. Circulating blood glucose levels are lowered by 20% and it is used in the patients with normal or minimally increased body weight.

Elliott et al [(78)] found that there is minimal transfer of glyburide across the placenta. Mother who is on glyburide, cord blood of their offspring does not reveal the drug . But FDA does not approve gluburide for the treatment of gestational diabetes and more studies are needed to establish their safety in the future.

Metformin is a biguanide (Insulin sensitizer) belongs to category B drug. It is not used routinely in pregnancy. Studies have shown that women who continue metformin in pregnancy incase of polycystic ovarian syndrome or in type 2 diabetes are found to have no adverse effects in their outcomes of pregnancy.

However there is a clinical trial which is ongoing in New Zealand which compares metformin with insulin in women with gestational diabetes.

ANTEPARTUM FETAL ASSESSMENT:

The method and frequency of fetal well being surveillance is determined by the level of maternal hyperglycemia and the presence of other associated adverse high risk factors.

Antepartum fetal assessment as recommended by ACOG is done in women with poor glycemic control, who require insulin to control their blood sugar levels, with a history of hypertensive disorders and adverse obstetrical outcomes. The type of antepartum tests used for fetal surveillance is non stress test and biophysical profile.

In women with well controlled diabetes, the role of antepartum fetal surveillance is not clear. Fourth International Workshop Conference on GDM recommends non stress test to start form 32 weeks of gestation in women on insulin and at or near term in those women with diet alone.[76]

Women with gestational diabetes should be taught about the importance of monitoring the fetal movements in the last 8 to 10 weeks of pregnancy and to report immediately when they have any reduction in the perceiving the fetal movements.

Recent studies have shown the importance of role of ultrasound in the fetus to guide the management of the women with gestational diabetes. When ultrasound done at 30 weeks of gestation showed abdominal circumference of

the fetus is greater than 70th percentile, it is usually associated with increased risk of macrosomia . So ultrasound is done every 4 weeks starting from 20 weeks of gestation. Therefore ultrasound play a major role in antepartum fetal assessment for further management in women with gestational diabetes.[69]

PERIPARTUM CONSIDERATIONS:

In women with gestational diabetes having good blood sugar control with no other complications, delivering the fetus before 40 weeks of gestation is not recommended.[79]

Women with GDM on insulin require frequent antenatal testing and are managed in the same way as women with overt diabetes. Early delivery by induction is done. The time and route of delivery depends on the fetal condition. Macrosomia is less common in well controlled GDM.

But according to American Diabetic Association, prolongation of pregnancy beyond 38 weeks of gestation increases the risk of macrosomia in the fetus without reduction in the rate of caesarean section, so delivery is done at 38th week. If a delivery is done before 39 weeks of gestation, lung maturity in the fetus is assessed by amniocentesis before induction of labor.[79]

Counseling is done in women in the presence of clinically and sonographically diagnosed macrosomia (Fetal weight >4.5 kg) for elective

caesarean section to avoid maternal and fetal trauma as recommended by ACOG.

When the estimated weight of fetus is between 4.0 to 4.5 kg, and when there are additional risk factors for shoulder dystocia, clinical pelvic examination is done and the progress of labor is monitored carefully. Women past delivery history is also considered.[79]

POSTPARTUM CONSIDERATIONS:

Women with gestational diabetes are more prone to develop type 2 diabetes mellitus in the future. After the pregnancy, maternal glycemic status is reclassified at 6 weeks or more after delivery and followed every 3 years to detect impaired glucose tolerance, diabetes mellitus, impaired fasting glucose, or normoglycemia.

Normal values for 2 hour OGTT are FBS <110 mg/dl and 2 hour post glucose load of 75 gm should be <140 mg/dl. Glucose values that meet the criteria for labeling as diabetes are FBS >126 mg/dl and 2-hr post glucose load is > 200 mg/dl.

If the blood sugar values fall between these two thresholds they are labeled as impaired fasting glucose and impaired glucose tolerance. (ADA 2003)

5th International Workshop Conference: Metabolic assessments recommended in women with GDM after pregnancy.

Time	Tests	Procedure
Post delivery (1 to 3 days)	Fasting or the random plasma glucose	Detect persistent, overt diabetes
Early postpartum (6 to 12 weeks)	75 gm with 2 hours OGTT	Postpartum classification of glucose metabolism
1 year postpartum	75 gm with 2 hours OGTT	Glucose metabolism is assessed
Annually	Fasting plasma glucose	Glucose metabolism is assessed
Tri anually	75 gm – 2 hours OGTT	Glucose metabolism is assessed
Prepregnancy	75 gm – 2 hours OGTT	Classify glucose metabolism

LIFE STYLE:

All women with history of gestational diabetes are educated about their life style modifications which lessen the insulin resistance that includes medical nutrition therapy, exercise, physical activity, maintaining normal body weight. Drugs which cause increased insulin resistance like steroids, nicotinic acid are better avoided. Women with GDM should be taught about the symptoms of hyperglycemia and to seek medical attention if they develop symptoms.

Recurrence of GDM in subsequent pregnancies is documented in two thirds of the patients.[80] Early breast feeding is always encouraged in women with GDM to prevent hypoglycemia in newborns and to reduce the childhood obesity.

Counseling before pregnancy and multidisciplinary management are important for good pregnancy outcomes. The main aim in the diet modification is to avoid peak values in blood glucose levels. It can be done by the use of carbohydrate sources with slow release and splitting carbohydrate intake into three meals and snacks throughout the day

Intake of foods with more fibers like fruits, vegetables and whole grains will decrease the risk of GDM. Blood sugar samples are used to determine HbA1C regularly that gives an idea of level of blood sugar control over a long period of time. [28]

CONTRACEPTION:

Education of patients with GDM should always include the need for family planning practices to ensure good glycemic status from starting of any subsequent pregnancies.

Women with prior gestational diabetes have many options in contraception and can have any form of contraception, as the same guidelines recommended in other women.

Barrier methods like condoms, cervical cap, diaphragm, and spermicides lack systemic side effects and they have no influence on glucose metabolism. So they are used safely in women with GDM. The main drawback is higher failure rate and high motivation of the patient and their partner.

Intrauterine devices (IUCD) are ideal contraception in women with prior GDM. They are very effective and reversible method without causing any disturbances in glucose metabolism. According to the Medical Eligibility Criteria for Contraceptive Use in 2004 report by World Health Organization prior GDM is not a contraindication for insertion of IUCD. [81]

Evidence from clinical studies support the use of low dose combined oral pills (COC) in women with prior GDM. Formulation of COC which contains ethinyl estradiol in lowest dose and progestins are prescribed in women with GDM like same precautions and recommendations as like in healthy women.

The risks or benefits of non oral combination methods are considered similar to that of COC and there is no specific data relating to gestational diabetes.[82] The rate of subsequent diabetes is not increased by the use of oral contraceptives. Progestins only pills are not used as the first choice of contraception in lactating mothers. [81]

Lastly sterilization is offered in the women who have completed their child bearing mainly to the parous women.

LONG TERM CONSEQUENCES OF GDM:

In most cases, GDM resolves following the delivery, but may recur in subsequent pregnancy, usually at progressive earliest gestational weeks. Women with GDM have increased risk of developing type 2 diabetes following delivery. Factors that causes increased risk of progression to type 2 diabetes mellitus includes gestational age at time of diagnosis of GDM, level of blood glucose control at diagnosis , at the first assessment in postpartum period, impairment of function in beta cells, obesity and further pregnancy.

Progression to diabetes also depends on the ethnicity. Women who need insulin to control blood sugar levels have a 50% risk to develop diabetes within next five years of life.[75] Women with more than two pregnancies and obesity are also other risk factors. The risk varies depending on the ethnicity,

diagnostic criteria and duration of follow up of the patients. The risk is higher in the first five years, after that it reaches a plateau level.

Infants born to the women with gestational diabetes are more prone to develop childhood and adult obesity and have increased risk for developing glucose intolerance and type 2 diabetes mellitus in their later life. [(83)] The risk is related to level of increased blood sugar values in the mother. [(84)]

Women who had GDM are provided appropriate health education on reducing cardiovascular risk factors, as the mortality and morbidity from the premature heart disease is increased.

The importance of weight maintenance and exercise is stressed for both cardiovascular protection and delaying the onset of type 2 diabetes mellitus and impaired glucose tolerance. The greatest protective effect of exercise in maintaining the glucose tolerance is conferred on the individuals at greatest risk.

MATERIALS AND METHODS

MATERIALS AND METHODS

Aims and objectives

- To determine perinatal outcome in relation to maternal fasting and postprandial (2 hours) blood sugar control in gestational diabetes mellitus.
- Perinatal outcomes included are macrosomia, Respiratory distress syndrome, hypoglycemia, seizures, hyperbilirubinemia, NICU admission, Anomaly, IUD, Stillbirth, perinatal injury, perinatal mortality.

Study place

The study was conducted at the Institute of Social Obstetrics, Government Kasturba Gandhi Hospital, Attached to Madras Medical College, Chennai.

Study Design

This was prospective study / observational study.

Study Period

The study was conducted for a period of one year from December 2012 to November 2013.

Participants

The study group consisted of 150 patients after considering the exclusion and inclusion criteria.

Inclusion criteria

- Singleton pregnancy
- Cut off value for FBS is $\leq$ 95mg/dl and PPBS (2 hours) is $\leq$120 mg/dl
- Blood sugar taken at the time of diagnosis of GDM, 2nd trimester and 3rd trimester towards term.
- Age < 35 years
- Primi and multigravida
- Antenatal GDM mothers on meal plan and insulin
- Cephalic presentation
- Women booked and immunized in KGH
- Women with regular antenatal visits
- Neonatal outcomes are observed for macrosomia, hypoglycemia, respiratory distress syndrome, seizures, hyperbilirubinemia, anomaly, stillbirth, IUD, perinatal morbidity and mortality.

Exclusion criteria

- Overt diabetes

- Abnormal presentation
- Preterm and PROM
- Associated medical disorders like hypothyroidism and hypertension
- Multiple pregnancy and IUGR
- First visit to KGH
- Normal antenatal mothers without GDM

Method of study

All antenatal mothers attending the OPD are subjected to 75 gm of glucose challenge test in first, second and third trimester. If GCT is elevated above 140 mg/dl, these patients are advised meal plan for 2 weeks. Fasting and postprandial blood sugars (2hours) are done.

If FBS and PPBS are normal, the patient is labeled as GDM on meal plan. If fasting > 96 mg/dl and 2-hr postprandial blood sugar > 121 mg/dl, insulin is started along with diet modification and patient is labeled as GDM on insulin. In patients with GDM on insulin FBS and PPBS are taken according to the blood sugar control and the dose of insulin is adjusted. In case of GDM on meal plan, FBS and PPBS are taken every 15 days.

If the GCT is normal is 1^{st} trimester, it is repeated again in 2^{nd} trimester at 24 weeks and 3^{rd} trimester in 32 weeks. If it is normal in 2^{nd} trimester, it is again done in 3^{rd} trimester.

Follow up the patients were done antenatally with fasting and postprandial blood sugar values and the dose of insulin is adjusted according to the blood sugar values. The patient is then followed intrapartum. Fetal outcomes are evaluated. Neonatal outcomes included are macrosomia, hypoglycemia, respiratory distress syndrome, seizures, hyperbilirubinemia, anomaly, stillbirth, IUD, perinatal morbidity and mortality.

RESULTS

RESULTS

Total no. of cases : 150

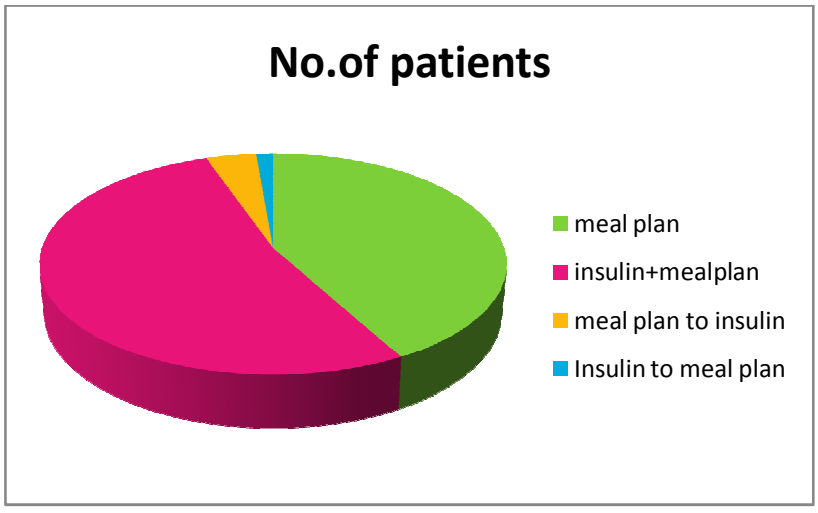
GDM on treatment

A total of 150 patients were included in the study. In this 63 patients were on meal plan, 79 patients were on insulin, 6 patients initially on meal plan were converted to insulin, 2 patients initially on insulin were converted to meal plan.

Table 1

GDM	No. of patients	%
Meal plan	63	42.0
Insulin with meal plan	79	52.7
Meal plan converted to insulin	6	4.0
Insulin converted to insulin	2	1.3
Total	150	100

Figure 1



Age distribution

Table 2: Shows the age distribution in GDM .60% of the patients were in age group of 26 to 30 years

Table 2

Age	No.of patients	%
20 - 25	26	17.3
26 -30	90	60
>30	34	22.7
Total	150	100

Figure 2

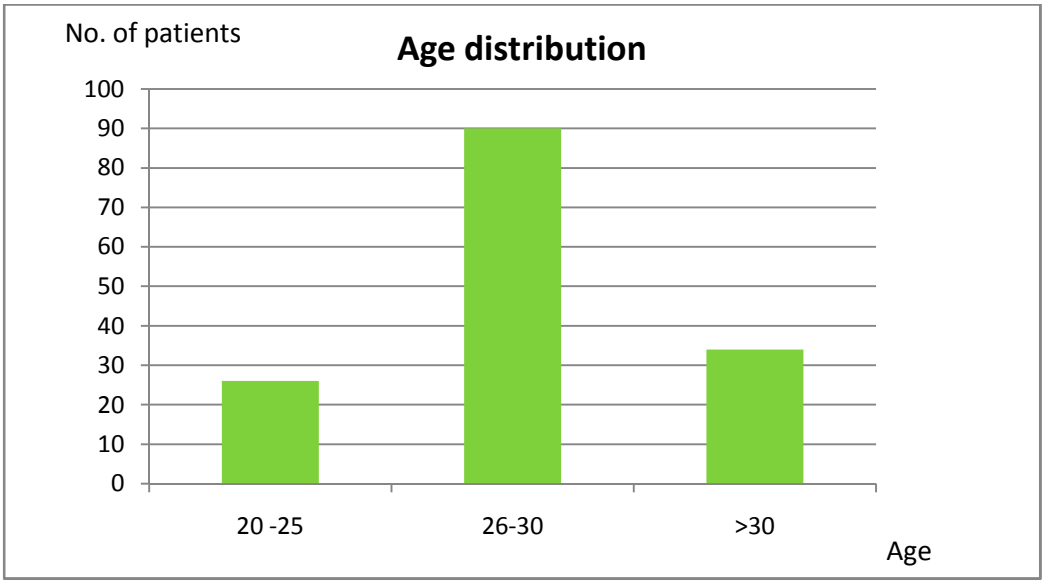


Table 3: Shows the relation of age with GDM.

Age in years	GDM on treatment					Total	**P Value**
		Meal plan	Insulin and meal plan	Meal plan to insulin	Insulin to meal plan		**.006**
20 - 25	No.	17	7	1	1	26	
	%	65.4	26.9	3.8	3.8		
26 – 30	No.	40	45	4	1	90	
	%	44.4	50	4.4	1.1		
>30	No.	6	27	1	0	34	
	%	17.6	79.4	2.9	0		
Total	No.	63	79	6	2	150	
	%	42	52.7	4	1.3		

P <0.05, there was significant association between age and onset of GDM.

BMI DISTRIBUTION

Table 4: Shows BMI distribution in GDM. 59.3% of patients were in BMI of range 25 - 30

BMI	No. of patients	%
18-24	39	26.0
25-30	89	59.3
>30	22	14.7
Total	150	100.0

Figure 3

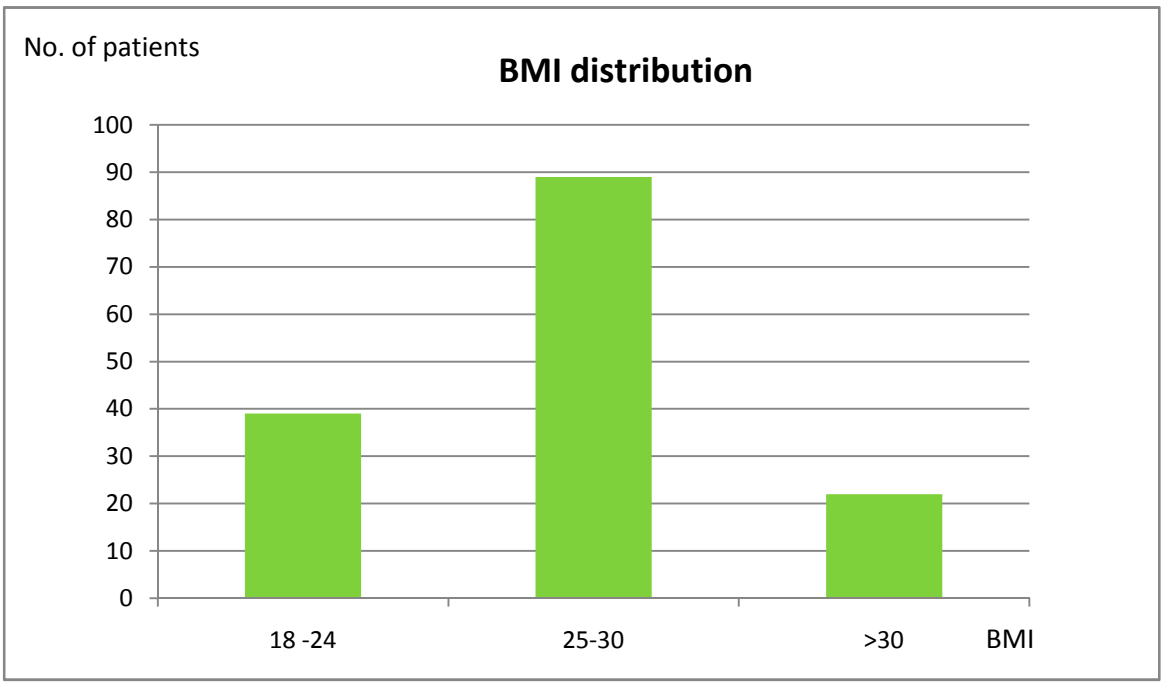


Table 5: Shows the relation of BMI with GDM.

BMI		GDM on treatment				Total	**P Value**
		Meal plan	Insulin and meal plan	Meal plan to insulin	Insulin to meal plan		**.000**
18-24	No.	39	0	0	0	39	
	%	100.0	0	0	0		
25-30	No.	24	59	4	2	89	
	%	27.0	66.3	4.5	2.2		
>30	No.	0	20	2	0	22	
	%	0	90.9	9.1	0		
Total	No.	63	79	6	2	150	
	%	42.0	52.7	4.0	1.3		

$P < 0.05$, there was significant association between BMI and GDM.

PARITY DISTRIBUTION

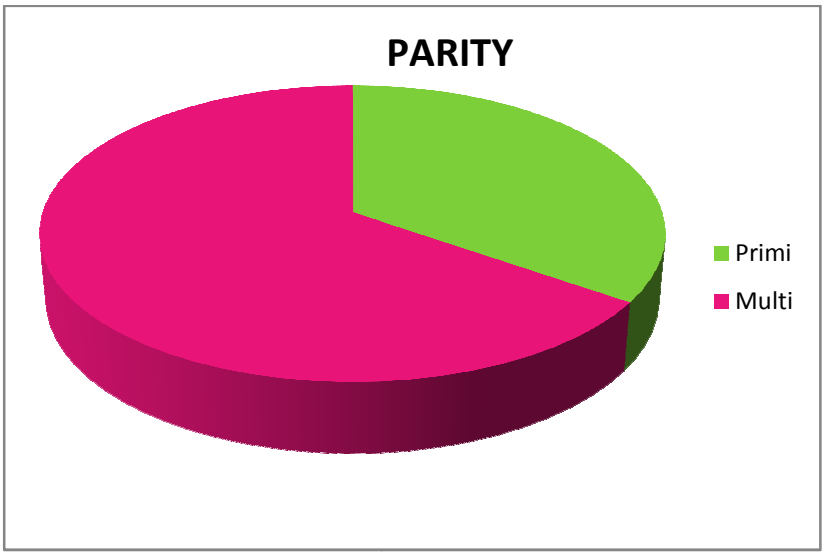
34.7% of the patients were primi and 65.3% were multi

Table 6

Parity		GDM on treatment				Total	%	**P Value**
		Meal plan	Insulin with meal plan	Meal plan to insulin	Insulin to meal plan			**.077**
Primi	No.	29	20	2	1	52	34.7	
	%	55.8	38.5	3.8	1.9			
Multi	No.	34	59	4	1	98	65.3	
	%	34.7	60.2	4.1	1.0			
Total	No.	63	79	6	2	150		
	%	42.0	52.7	4.0	1.3			

P > 0.05, there was no significant association between parity and GDM.

Figure 4



FAMILY HISTORY OF DIABETES

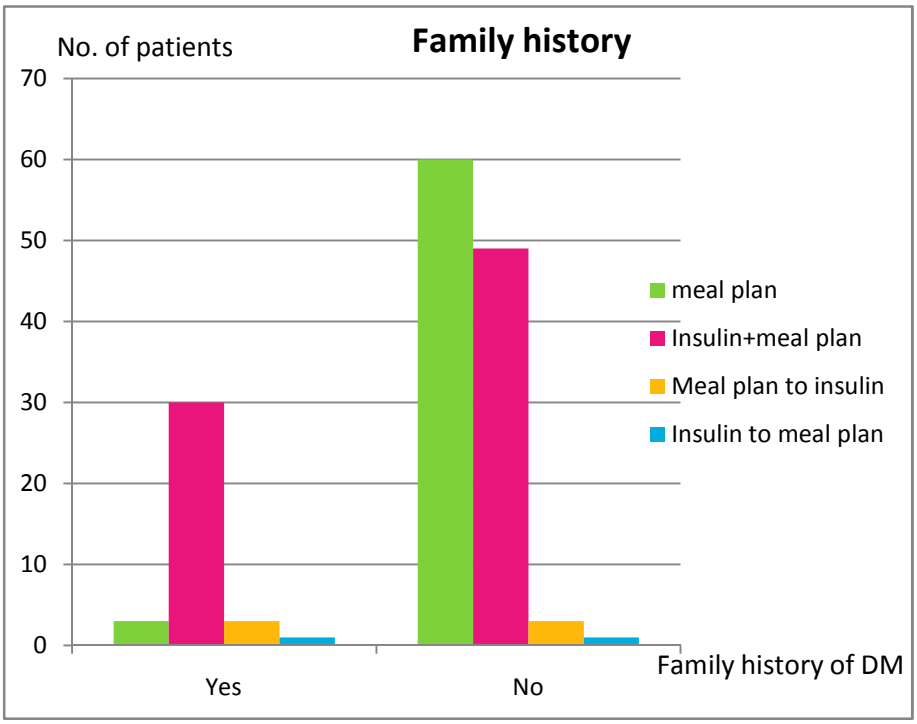
Family history of diabetes was present in 24.7% of the patients.

Table 7: shows the family history of diabetes in patients with GDM**.**

Family History		GDM on treatment				Total	%	**P Value**
		Meal plan	Insulin and meal plan	Meal plan to insulin	Insulin to meal plan			**.000**
Present	No**.**	3	30	3	1	37	24.7	
	%	8.1	81.1	8.1	2.7			

P < 0.05, there was significant association between presence of family history of diabetes and the occurrence of GDM.

Figure 5



PREVIOUS GDM

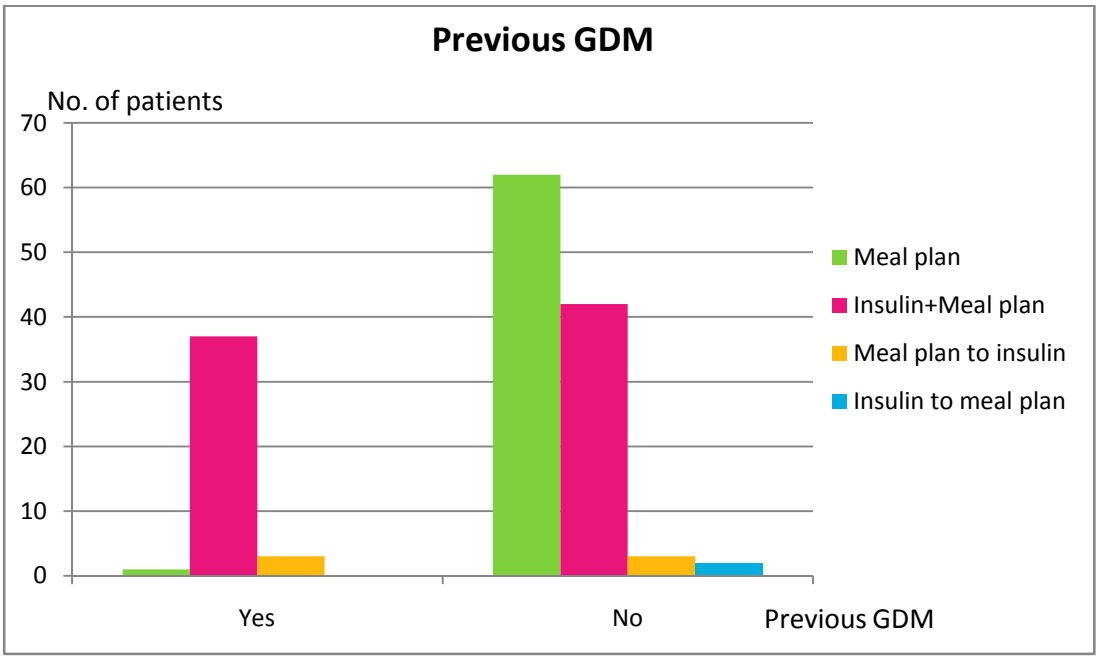
Previous history of GDM was present in 27.3% of cases.

Table 8

Previous GDM		GDM on treatment				Total	%	**P Value** **.000**
		Meal plan	Insulin and meal plan	Meal plan to insulin	Insulin to meal plan			
Present	No. of patients	1	37	3	0	41	27.3	
	%	2.4	90.2	7.3	0			

P < 0.05, there was significant association between the presence of GDM in previous pregnancy and the occurrence of GDM in present pregnancy.

Figure 6



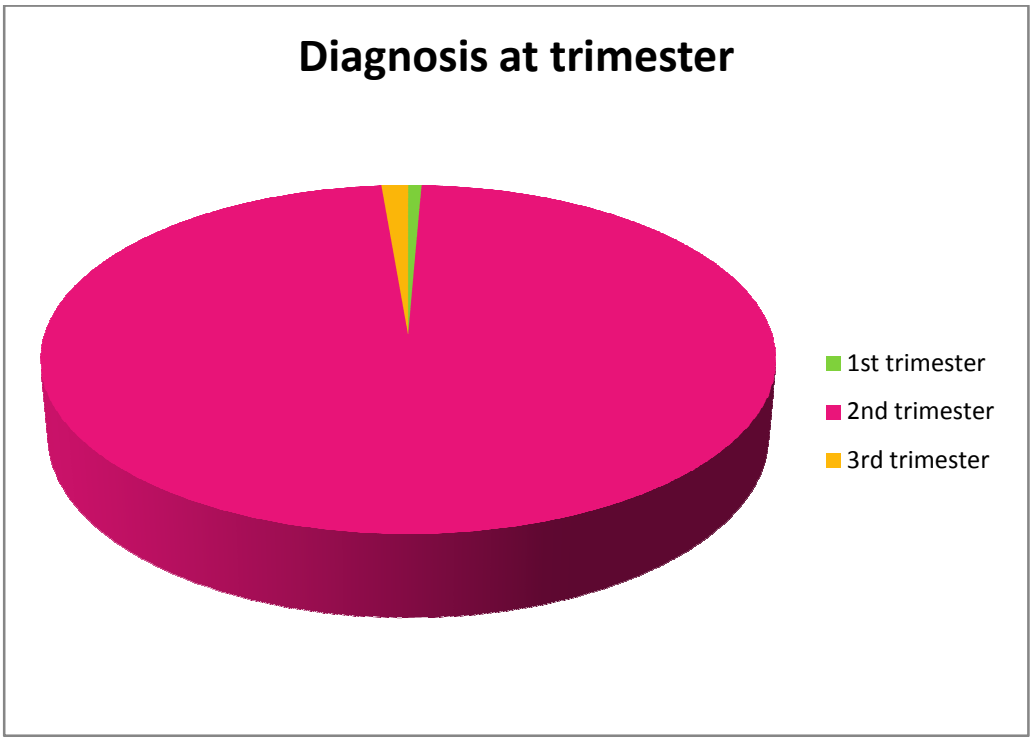
Diagnosis at trimester

98% of GDM were detected in 2nd trimester.

Table 9: Shows the diagnosis of GDM according to trimester of pregnancy.

Diagnosis	No. of patients	%
1st trimester	1	0.7
2nd trimester	147	98.0
3rd trimester	2	1.3
Total	150	100.0

Figure 7



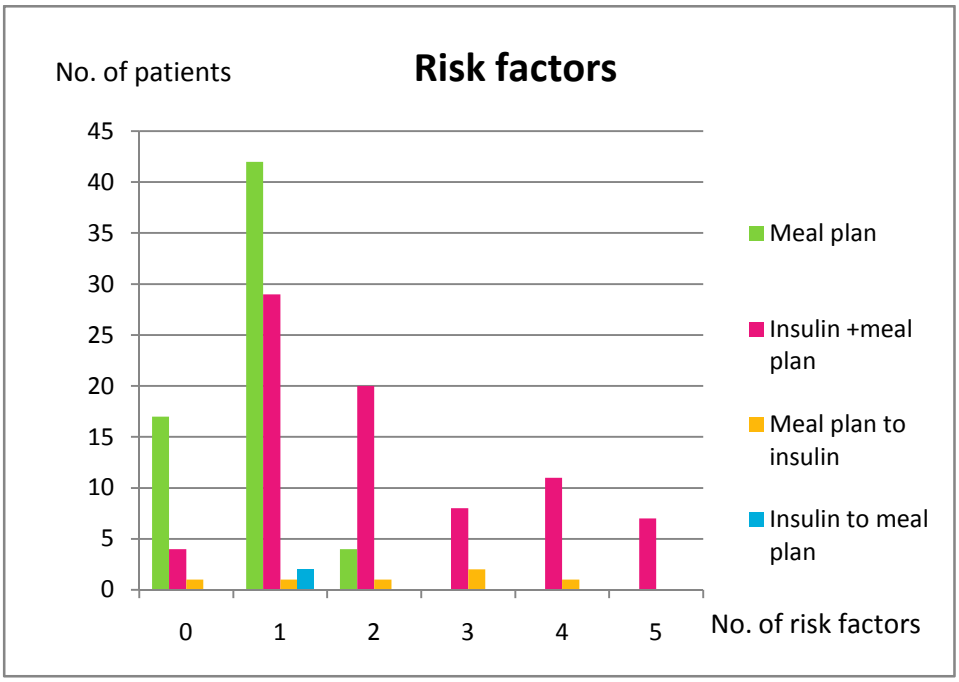
Risk factors with GDM

TABLE 10: shows the number of risk factors and the occurrence of GDM.

No. of risk factors		GDM on treatment					**P Value**
		Meal plan	Insulin and meal plan	Meal plan to insulin	Insulin to meal plan	Total	**.000**
0	No.	17	4	1	0	22	
	%	77.3	18.2	4.5	0		
1	No.	42	29	1	2	74	
	%	56.8	39.2	1.4	2.7		
2	No.	4	20	1	0	25	
	%	16	80	4	0		
3	No.	0	8	2	0	10	
	%	0	80	20	0		
4	No.	0	11	1	0	12	
	%	0	91.7	8.3	0		
5	No.	0	7	0	0	7	
	%	0	100	0	0		
Total	No.	63	79	6	2	150	
	%	42	52.7	4.0	1.3		

P < 0.05, there was significant association between number of risk factors and the occurrence of GDM. The risk factors included are 1) age > 25 years 2) BMI >30 3) family history of diabetes 4) previous GDM 5) gestational hypertension.

Figure 8



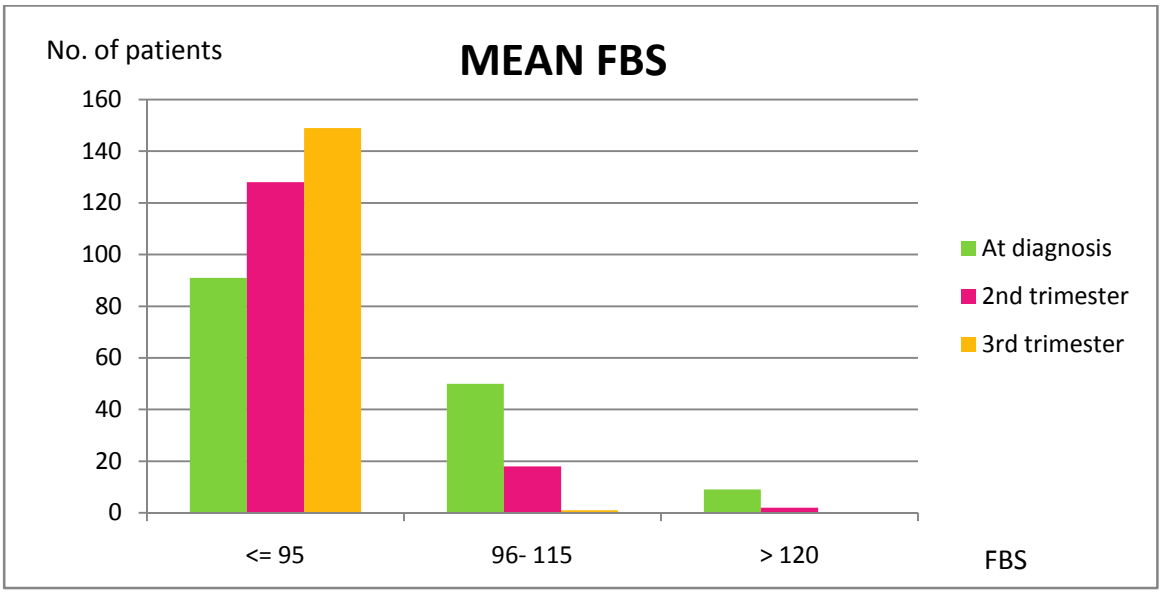
FBS & PPBS at time of diagnosis

At the time of diagnosis 60.7% of patients had FBS ≤ 95 mg/dl and 46% of patients had PPBS ≤ 120 mg/dl.

Table 11

FBS (in mg/dl)	No. of patients	%
≤95	91	60.7
96-119	50	33.3
≥120	9	6.0
PPBS (in mg/dl)	**No. of patients**	**%**
≤ 120	69	46.0
121-159	26	17.3
160-199	52	34.7
≥ 200	3	2.0

Figure 9



FBS and PPBS in 2nd trimester

Blood sugar values FBS ≤ 95 mg/dl was seen in 85.3% and PPBS ≤ 120 mg/dl was seen in 43.3% of cases

Table 12

FBS (in mg/dl)	No. of patients	%	PPBS (in mg/dl)	No. of patients	%
≤95	128	85.3	≤ 120	65	43.3
96-119	18	12.0	121-159	51	34.0
≥120	2	1.3	160-199	31	20.7
			≥ 200	1	0.7
Total	148	98.7	Total	148	98.7
Missing	2	1.3	Missing	2	1.3
Total	150	100	Total	150	100

2 cases are not detected in 2nd trimester because of normal value of GCT; elevated GCT was detected in 3rd trimester.

FBS & PPBS in 3rd trimester

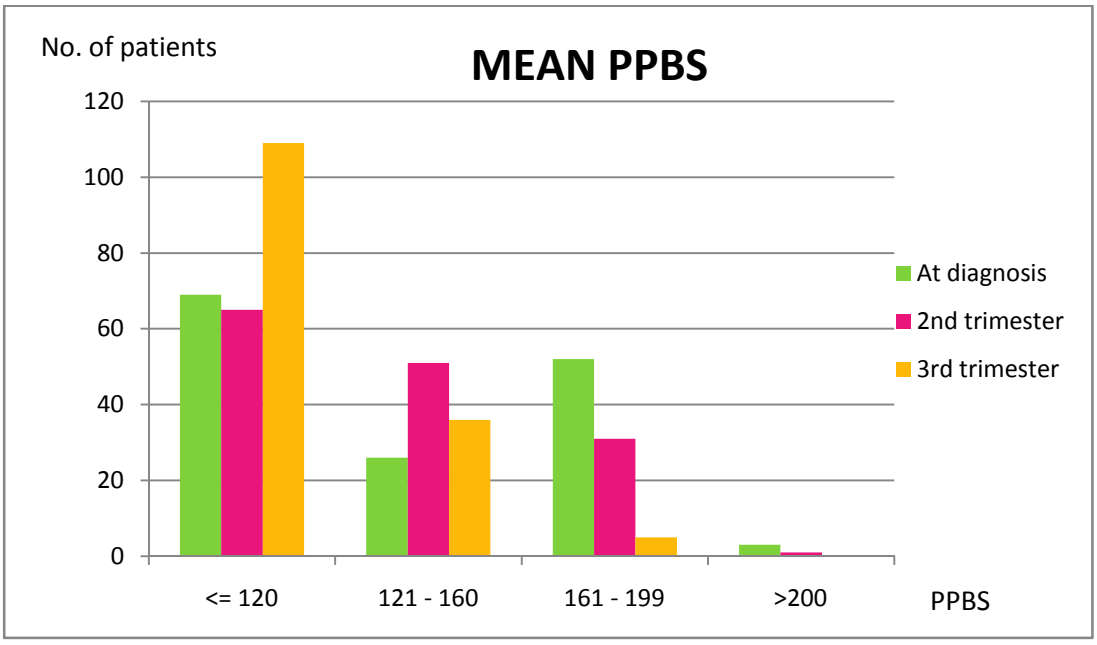
Ideal blood sugar values FBS ≤ 95 mg/dl was seen in 99.3% and PPBS ≤ 120 mg/dl was seen in 72.7% of cases by effective treatment.

Table 13

FBS (in mg/dl)	No. of patients	%
≤95	149	99.3
96-119	1	0.7
PPBS (in mg/dl)	**No. of patients**	**%**
≤ 120	109	72.7
121-159	36	24.0
160-199	5	3.3

There was no case with FBS ≥ 120 mg and PPBS ≥ 200 mg.

Figure 10



MODE OF DELIVERY

The percentage of patients who had caesarean section was 42% (Both LSCS and repeat LSCS), the most common indication being Previous LSCS and CPD.

Table 14

Mode of delivery	No. of patients	%
Labor natural	82	54.7
Instrumental delivery	5	3.3
LSCS	34	22.7
Repeat LSCS	29	19.3
Total	150	100.0

INDICATION FOR LSCS

Table 15

Indication	No. of patients	%
Fetal distress	9	14.3
CPD	14	22.2
Failed induction	11	17.5
Previous LSCS	29	46.0
Total	63	100.0

Adverse neonatal outcomes

Table 16: Shows the number of adverse neonatal outcomes in GDM.

Adverse neonatal outcomes	GDM on treatment					Total	**P Value**
		Meal plan	Insulin and meal plan	Meal plan to insulin	Insulin to meal plan		
Macrosomia	No.	0	13	0	0	13	
	%	0	100	0	0		**.005**
RDS	No.	0	5	0	0	5	**.199**
	%	0	100	0	0		
Hypoglycemia	No.	0	9	0	0	9	
	%	0	100	0	0		**.035**
Hyperbilirubinemia	No.	0	5	0	0	5	
	%	0	100	0	0		**.199**
IUD	No.	0	1	0	0	1	
	%	0	100	0	0		**.824**
Perinatal morbidity	No.	0	2	0	0	2	
	%	0	100	0	0		**.610**
NICU Admission $\geq$ 3 days	No.	1	17	0	0	18	
	%	5.6	94.4	0	0		**.002**

The percentage of cases presented with Macrosomia was 8.7%, RDS 3.3%, hypoglycemia 6%, hyperbilirubinemia 3.3%, IUD 0.7%, perinatal injury 1.3%, NICU admission requiring more than 3 days of admission was 12%. There were no cases of seizures (due to hypoglycemia or hypocalcemia), still birth, anomaly, perinatal mortality.

$P < 0.05$, there was significant association between GDM and occurrence of macrosomia, hypoglycemia and NICU admission $\geq$ 3 days in neonates. $P > 0.05$, there was no significant association between GDM and the occurrence of RDS, hyperbilirubinemia, IUD, perinatal morbidity

Risk factors with neonatal outcomes

Table 17 compares the number of risk factors in the mother such as 1)age > 25 years 2) BMI >30 3) family history of diabetes 4)previous GDM 5) gestational hypertension with the occurrence of adverse neonatal outcomes.

Table 17

No. of risk factors	Adverse Neonatal outcomes		**P Value**
	No**.**	%	**.265**
0	0	0	
1	11	14.9	
2	3	12	
3	2	20	
4	3	25	
5	2	28.6	
Total	21	14	

P > 0.05, there was no significant association between number of risk factors and adverse neonatal outcome.

Fasting blood sugar

Table 18: Shows the fasting blood sugar values at the time of diagnosis, at 2nd trimester, 3rd trimester

FBS (in mg/dl)	**At time of diagnosis**		**At 2nd trimester**		**At 3rd trimester**	
	No. of patients	%	No. of patients	%	No. of patients	%
≤95	91	60.7	128	85.3	149	99.3
96-119	50	33.3	18	12.0	1	0.7
≥120	9	6.0	2	1.3	0	0
Total	-	-	148	98.7	-	-
Missing	-	-	2	1.3	-	-
Total	150	100	150	100	150	100

2 cases are not detected in 2nd trimester because of normal value of GCT; elevated GCT was detected in 3rd trimester.

FBS and adverse neonatal outcome

Table 19: Shows adverse neonatal outcomes according to the level of fasting blood sugar control.

FBS (in mg/dl)	**Adverse neonatal outcomes**					
	At time of diagnosis		**In 2nd trimester**		**In 3rd trimester**	
	No.	%	No.	%	No.	%
≤ 95	5	5.5	15	11.7	20	13.4
96-119	10	20	4	22.2	1	100
≥ 120	6	66.7	2	100	0	100
P Value	**.000**		**.001**		**.013**	

As the fasting blood sugar increases, percentage of adverse neonatal outcome increases. Since P <0.05, there was significant association between FBS and the occurrence of adverse neonatal outcomes.

Post prandial blood sugar

Table 20: Shows the postprandial blood sugar values at the time of diagnosis, at 2nd trimester, 3rd trimester.

PPBS (in mg/dl)	At time of diagnosis		In 2nd trimester		In 3rd trimester	
	No. of patients	%	No. of patients	%	No. of patients	%
≤ 120	69	46.0	65	43.3	109	72.7
121-159	26	17.3	51	34.0	36	24
160-199	52	34.7	31	20.7	5	3.3
≥ 200	3	2.0	1	0.7		
Total			148	98.7		
Missing			2	1.3		
Total	150	100	150	100	150	100

2 cases are not detected in 2nd trimester because of normal value of GCT; elevated GCT was detected in 3rd trimester.

PPBS and adverse neonatal outcomes

Table 21: Shows adverse neonatal outcomes according to the level of postprandial blood sugar control.

	Adverse neonatal outcomes					
	At time of diagnosis		In 2nd trimester		In 3rd trimester	
PPBS (in mg/dl)	No.	Percent	No.	Percent	No.	Percent
≤ 120	4	5.8	5	7.7	6	5.5
121-159	2	7.7	5	9.8	12	33.3
160-199	12	23.1	10	32.3	3	60
≥ 200	3	100	1	100	0	100
P Value	**.000**		**.001**		**.000**	

As the postprandial blood sugar increases, Percentage of adverse neonatal outcome increases. $P < 0.05$, there was significant association between PPBS and occurrence of adverse neonatal outcomes.

DISCUSSION

DISCUSSION

Glucose intolerance in pregnancy can be of varying severity depending on risk factors and the glycemic control. Therefore early diagnosis, adequate treatment and follow up are essential in managing the patients with GDM.

WHO criteria 75 gm of glucose load and 2hour plasma glucose was able to correctly identify the patients with GDM.[8] In present study WHO criteria was followed for screening and patients with GDM were detected. ACOG criteria was used for cut of values to maintain normal blood sugar FBS $\leq$ 95mg/dl and PPBS $\leq$ 120 mg/dl

RISK FACTORS

According to ACOG criteria, age > 25 years and BMI > 30 were considered as high risk factor**.** In present study, 82.7% patients were > 25 years and 14.7% of the patients had BMI > 30. Since P value < 0.05, it was concluded that there were significant association between age and BMI with GDM since P value < 0.05.

Multiparous women (65.3%) were more affected than primigravida (34.7%). Since P value >0.05, there was no significant association between parity and occurrence of GDM.

In a study by **Catherin et al** (2009) family history of diabetes mellitus were present in 35% of cases. In present study family history was present in 24.7% of

cases .Since P value is < 0.05, there was a significant association between family history of diabetes mellitus and occurrence of GDM in pregnancy.

In a study by **Catherin et al** (2007) [80] history of gestational diabetes in previous pregnancy was associated with occurrence of GDM in present pregnancy. In present study, previous history of GDM was present in 27.3% of cases. There was a significant association between previous GDM history with onset of GDM in index pregnancy since P value < 0.05. In study by **Yogev et al** [85] the incidence of preeclampsia in GDM with good glycemic control was 7.8%, in present study it was 8.7% of cases.

There was a significant association between number of risk factors and the occurrence of GDM.

But there was no significant association between the number of risk factors and the occurrence of adverse neonatal outcomes.

GDM screening should be started in first trimester. [8] Early detection and blood sugar control results in better fetal outcome. In present study 98% cases were detected in 2nd trimester, 0.7% and 1.3% of cases were detected in 1st trimester and 3rd trimester respectively.

OPERATIVE DELIVERY

OPERATIVE DELIVERY	
AUTHOR	Percentage
Evers et al [86]	44
Yogev et al [87]	30
Present study	42

The percentage of patients who had caesarean section was 42% (Both LSCS and repeat LSCS), the most common indication being Previous LSCS (46%) and CPD (22.2%).

NEONATAL OUTCOMES:

Jacques et al found the incidence of NICU admission was 16%, respiratory distress syndrome was 6.9%, hypoglycemia 3.2%. **Evers et al** [(86)] found the incidence of respiratory distress syndrome to be 15%, hyperbilirubinemia as 25%, macrosomia as 45%. In study by **Casson et al** the incidence of still birth was 2.5%. A study by **priyanka et al** [(88)] showed the incidence of macrosomia was 18%, NICU admission 27.2%, hypoglycemia 9%, hyperbilirubinemia 12%. In a study by **Preeti et al** showed the incidence of respiratory distress syndrome was 3.23%, perinatal inhury was 1.4%, macrosomia was 7%.

In the present study the incidence of macrosomia was 8.7%, RDS 3.3%, hypoglycemia 6%, hyperbilirubinemia 3.3%, IUD 0.7%, perinatal injury 1.3%, NICU admission requiring more than 3 days of admission was 12%.

$P < 0.05$, there was a significant association between GDM and the occurrence of macrosomia, hypoglycemia and NICU admission $\geq$ 3 days in neonates. $P > 0.05$, there was no significant association between GDM and the occurrence of RDS, hyperbilirubinemia, IUD, perinatal morbidity.

There were no cases of seizures (due to hypoglycemia or hypocalcemia), still birth, anomaly, perinatal mortality.

SUMMARY

SUMMARY

Total of 150 patients were included in the study. Of which 63 was on meal plan, 79 was on insulin and meal plan, 6 was on meal plan converted to insulin, 2 was on insulin converted to meal plan.

Age >25 years was the single most important risk factors. There was a significant association between age and the occurrence of GDM.

BMI > 30 was also a risk factor for GDM. There was a significant association between BMI and the occurrence of GDM.

There was a significant association between the presence of family history of diabetes and the occurrence of GDM in the index pregnancy.

There was also a significant association between the presence of GDM in previous pregnancy and its occurrence in index pregnancy.

History of PIH was also a risk factor associated with GDM.

So to conclude there was a significant association between the number of risk factors and the occurrence of GDM.

Most cases of GDM were detected in 2^{nd} trimester of pregnancy.

Ideal fasting blood sugar level of $\leq$ 95 mg /dl was seen in 60.7% of patients at the time of diagnosis, with treatment effective blood sugar control was achieved in 99.3 % of patients. Ideal post prandial blood sugar level of $\leq$ 120 mg/dl was

seen in 46 % of patients at the time of diagnosis; with treatment effective blood sugar control was achieved in72.7 % of patients.

Caesarean section was done in 42% of patients (Both LSCS and repeat LSCS), the most common indication being Previous LSCS (46%) and CPD (22.2%).

The percentage of cases presented with Macrosomia was 8.7%, RDS 3.3%, hypoglycemia 6%, hyperbilirubinemia 3.3%, IUD 0.7%, perinatal injury 1.3%, NICU admission requiring more than 3 days of admission was 12%. There were no cases of seizures (due to hypoglycemia or hypocalcemia), still birth, anomaly, perinatal mortality.

There was a significant association between GDM and the occurrence of macrosomia, hypoglycemia and NICU admission $\geq$ 3 days in neonates and there was no significant association between GDM and the occurrence of RDS, hyperbilirubinemia, IUD, perinatal morbidity.

There was a significant association between FBS and PPBS and the occurrence of adverse neonatal outcomes.

CONCLUSION

CONCLUSION

There is relationship between fasting and postprandial blood sugar values and neonatal outcomes. Early diagnosis and treatment of gestational diabetes with adequate antenatal care are essential to reduce the adverse neonatal outcomes. So universal screening in early gestation is recommended. Early detection of GDM and adequate blood sugar control is done to reduce the adverse neonatal outcomes. There is no relationship between the number of risk of risk factors and adverse neonatal outcomes. But when the number of risk factors increases the risk for GDM is increased.

BIBLIOGRAPHY

BIBLIOGRAPHY

1. American diabetic association : Report of the expert committee on the diagnosis and the classification of gestational diabetes mellitus. Diabetes Care January 2003 vol.26 no. suppl 1s 103-s105.
2. American Diabetes Association . Gestational Diabetes Mellitus . Diabetes Care 2004; 27: S 88- 90.PMID 14693936
3. White P. Pregnancy complicating pregnancy diabetes. Am J Med 1949; 7: 609. PMID 15396063
4. ACOG. Precis V. An update on Obstetrics and Gynecology. ACOG [1994].p.170.ISBN 0915473224
5. Carr DB, Gabee S. Gestational diabetes : Detection , Management, and Implications. Cli Diabetes 1998; 16(1):4
6. Buchanan TA, Xiang AH. Gestatioanl diabetes mellitus. J Clin Invest 2005 ; 115(3): 485-491. PMID 15765129
7. JL Bartha, P Martinez – Del Fresno, R Comino- Delgad, Early diagnosis of gestational diabetes and prevention of diabetes related complications, Eurr J. Obstet Gynecol Reprod, Biol 109, 1(2003) 41-44.
8. V Balaji, MS Balaji, V Seshiah, S Mukundan, M Datta, Maternal glycemia and neonatal birthweight in asian women, Diabetes Res Clin Prac, 73, 2 (2006) 223-4.
9. Nahum GG, Wilson SB, Stanislaw H, Early pregnancy glucose screening for gestational diabetes, J.Repro Med 47, 8 (2002) 656-62
10. Reiher H, Fuhramann K, Noack S, Woltanski KP, Jutzi E, Hahn von Dorsche H et al. Age-dependent insulin secretion of the endocrine pancreas in vitro from fetuses of diabetic and non-diabetic patients. Diabetes Care 1983; Sep-Oct 6(5): 446-51.
11. Schwartz R, Gruppuso PA, Petzold K, Brambilla D, Hiilesmaa V, Teramo KA Hyperinsulinemia and macrosomia in the fetus of the diabetic mother.Diabetes Care 1994; July 17 (7):640-8.
12. Seshiah V, Cynthia A, Balaji V, Balaji MS, Ashalata S, Sheela R et al. Detection and Care of women with gestational diabetes mellitus from early weeks of pregnancy results in birth weight of newborn babies appropriate for gestational age. Diab Res Clin Pract. 2008 May; 80 (2): 199-202.

13. Seshiah V, Balaji V, Balaji MS, Paneerselvam A, Arthi T, Thamizharasi M, et al. Gestational Diabetes Mellitus manifests in all trimesters of pregnancy.Diabetes Res Clin Pract. 2007 Sept; 77(3): 482-4.
14. O' Sullivan S.B, Mahan C.M, Choles D, Dandrow R, Screening criteria for high risk gestational diabetic patients. Am. J . Obstetric Gynecology 1973; 116: 895 – 900.
15. E.Cosson et al : Screening and insulin sensitivity in gestational diabetes. 40th Annual Meeting of the EASD, September 2004: A 350.
16. Anjalakshi chandrasekar, Evaluation of diagnostic criteria for abnormal glucose tolerance in south India pregnant women, Diabetes in pregnancy study group India, 2002 : 34- 37
17. Beischer NA, Oats JN, Henry OA, Sheedy MT, Walstab JE. Incidence andseverity of gestational diabetes mellitus according to country of birth inwomen living in Australia. Diabetes 1991 Dec; 40 Suppl 2: 35-8.
18. Dornhorst A, Paterson CM, Nicholls JS, Wadsworth J, Chiu DC, Elkeles RS etal. High prevalence of GDM in women from ethnic minority groups. DiabetMed. 1992 Nov; 9 (9): 820-5.
19. Cousins L, Bani L, Chez R, Coustan D, Gabee S, Sacks D, Singh s: Screening recommendations for GDM; Am. J. Obstet gynecol.1991, Sep 165 : 493-6
20. Ardawi MS, Nasart HA, Jamal HS, Al- Sagaef HM, Mustafa BG. Screening for GDM in pregnant females; Saudi med J. 2000 Feb 21: 155 – 60
21. Moses RG. Is it time to modify the Glucose Tolerance Test for the Diagnosis of Gestational Diabetes Diabetes Care 1995 June; 18(6): 886.
22. Anjalakshi C, Balaji V, Balaji MS, Ashalata S, Suganthi S, Seshiah V et al. A single test procedure to diagnose gestational diabetes mellitus. Acta Diabetol. 2009 Mar; 46 (1): 51-54.
23. Laird MD, Mc Farland MD, face KF. Fasting blood glucose and the initiation of insulin therapy in gestational diabetes. Endocr Prac 1996, 2: 330-2
24. Coustan DR, Widness JA, Carpenter MW, Pratt DC. The breakfast tolerance test; Screening for GDM with a standard mixed nutrient meal.Am. J. Obstet Gnyecol 1987; 157; 1113
25. Caraueo – Enriquezve, Tauano – Colaizzik: Evaluation of breakfast as screening test for the detection of GDM. Ginecol. Obstet.Max 2002, March, 70; 112 – 7

26. Nasrat AA, Johnstone FD, Hasan SA. Is random plasma glucose an effective screening test for abnormal glucose tolerance in pregnancy: Br J Obstet Gynecol 1988; 95 : 855- 60
27. V Seshiah, V Balaji, Madhuri S Balaji, Aruna S, CB Sanjeevi, Andera Green J Obstet Gynecol Ind Ded 2005, vol.55,6.
28. Agarwal MM, Dhatt GS, Punnuse J, Koster G – Gestational diabetes – a reappraisal of HbA1C as a screening test – Actra Obstet Gynecol Scand, 2005, Dec : 89 : 1159- 63
29. G. Legnizaman, M.Igarzabal, E.Reece – Periconceptional care of women with diabetes mellitus. Obstetrics and Gynaecology clinics of North America, Vol 34, Issue 2, Pg 225- 239
30. Costomis R,Desjarlais F, Ngugen M, Beauregard H – Clinical usefulness of estimation of serum fructosamine concentration as screening test for gestational diabetes. Am J Obstet Gynecol 1989, Mar, 160 : 651- 4
31. H.M.H Hofmann, Fructosamine in relation to maternofetal glucose and insulin homeostasis in gestational diabetes, Archives of Gyn and Obs, July 1990, Vol 247, No. 4.
32. Chen WW, Sese L, Tantahesam P et al : Pregnancy associated with renal glycosuria, Obstet Gynecol 1976; 47 :37.
33. Metzger BE, Bunchanan TA, Coustan DR, et al : Summary and recommendations of fifth international workshop – Conference in Gestational Diabetes. Diabetes Care 30 suppl 2 : S251, 2007
34. Carpenter MW, Coustan DR. Criteria for screening tests for gestational diabetes. Am J Obstet Gynecol 144 : 768- 773, 1982
35. O' Sullivan JB, Mahan CM : Criteria for the oral glucose tolerance test in pregnancy. Diabetes 13: 278 -285, 1964
36. Sacks DA, Greenspoon JS, Abu-Fadil S, Henry HM, Wolde – Tsadikt G, yao JFF : Toward universal criteria for gestational diabetes : the 75- gram glucose tolerance test in pregnancy. Am J Obstet Gynecol 172:607-614, 1995.Diabetes Care, 2007: S251-S260
37. M.I. Schmidt et al for the Brazillian gestational diabetes study group. Gestational diabetes diagnosed with 2 hr 75 gm oral glucose tolerance test and adverse pregnancy outcome, Diabetes care, July 2001 : 24(7), 1151 – 1155.
38. Fisher, P.M., Hamilton, P.M., Sutherland, H.W. and Stoers, J.M. (1974), THE EFFECT OF PREGNANCY ON INTRAVENOUS GLUCOSE

TOLERANCE. BJOG : An international journal of Obstetrics & Gynaecology, 81 : 285-290. doi: 111/j.1471-0528. 1974.tb00461.x
39. Pedersen J, Pathogenesis of the characteristic features of newborn infants of diabetic women, Williams and Wilkins 1967 : 128- 137.
40. Mitanchez D. Fetal and neonatal complications of gestational diabetes. J Gynecol Obstet Biol Reprod (Paris) 2010 Dec :39(8 Suppl 2) : S189-99. Doi : 10.1016/So368-2315(10)70046-6
41. Mathew M, Machado L, Al- Ghabshi R, Al- Haddabi R. Fetal macrosomia. Risk factor and outcome. Saudi Med J.2005 Jan: 26 (1): 96- 100.
42. Oral E, Cagdas A, Gezer A, Kaleli S, Aydinli K, Ocer F. Perinatal and maternal outcomes of fetal macrosomia. Eur J Obstet Gynecol Reprod Biol.2001 Dec 1:99(2):167-71
43. Word play MP, Hawdon JM, Hypoglycemia in the neonate. In Gregory JW, Aynsley-Green A, Landon and Bailier Tindall ; 1993 : 669-82
44. R.Al- Khalifah, A. AL-Subaihin, T.Al- Kharfi, S. Al- Alaiyan, and Khalid M.A lFaleh. Neonatal Short- Term Outcomes of Gestational Diabetes Mellitus . J Clinic Neonatol. 2012 Jan- Mar; 1(1) : 29- 33.PMCID : PMC 3761990
45. Agarwal RK, Lui K, Gupta JM. Neonatal hypoglycemia in infants of diabetic mothers. J Paediatr Child Health. 2000 Aug; 36(4) :354-6
46. Cornblath M, Hawdon JM, Williams AF, et al. Controversies regarding definition of neonatal hypoglycemia : suggested operational thresholds. Pediatrics. May 2000: 105(5): 1141-5
47. Person B, Hanson U. Neonatal morbidities in gestational diabetes mellitus. Diabetic care 1998: 21 (Suppl 2) : B 79-84
48. Jimenez- Moleaon JJ, Bueno- Cavanillas A, Luna-del-Castillo Jde D, Garcia-Martin M, Lardelli-Claret P, Galvez- Vargas R. Impact of different levels of carbohydrate intolerance on neonatal outcomes classically associated with gestational diabetes mellitus. Eur J Obstet Gynecol Reprod Biol 2002 Apr 10; 102(1): 36-41
49. Charles F potter, Ted Rosenkrantz. Infant of diabetic mother. May 10, 2013
50. Kios SL, Walther FJ, Montoro M, Paul RH, Diaz F, S tabler M. Prevalence and etiology of respiratory distress in infants of diabetic mothers : Predictive value of fetal lung maturation tests. Am J Obstet Gynecol1990 Sep: 163(3) : 898-903
51. Mayo Foundation for Medical Education and Research 1998-2013. DS00316 March 2011

52. CHRISTINA L. HERMANSEN, and KEVIN N. LORAH, Lancester. Respiratory Distress in the newborn. Am Fam Physician. 2007 Oct 1: 76(7):987-994
53. Tutdibi E, Gries K, Buchler M, Misselwitz B, Schlosser RL, Gortner L SO.Impact of labor on outcomes in transient tachpnea of the newborn: Pediatrics.2010; 125(3): e577
54. Jennifer M. Perkins, Julia P. Dun, Shubhada M. Jagasia. Perspectives in Gestational Diabetes Mellitus : A Review of Screening, Diagnosis, and Treatment. Clinical Diabetes April 2007 vol. 25 no.2 57-62
55. Mary Helen Black, David A. Sacks, Anny H. Xiang, Jean M. Lawrence, Clinical Outcomes of Pregnancies Complicated by Mild Gestational Diabetes Mellitus Differ by Combinations of Abnormal Oral Glucose Tolerance Test Values. Diabetes Care December 2010 vol.33 no. 12 2524-2530
56. Peace I Opara, Tamunopriye Jaja and Uche C Onubogu. Morbidity and mortality amongst infants of diabetic mothers . Italian Journal of Pediatrics 2010, 36:77 doi 1o.1186/ 1824-7288-36-77
57. Turki Gasim. Gestational Diabetes Mellitus : Maternal and perinatal outcomes. Oman Med J. 2012 March; 27(2) : 140- 144. PMCID : PMC3321340
58. Tyrala EE. The infant of the diabetic mother. Obstetrics and Gynaecology. Clinics of North America. 1996;23:221-41
59. Esra E. Onal, Ibrahim M. Hirfanoglu, Serder Beken, Nilgun Altuntas, Canan Turkyilmaz, Aysu Duyan Camurdan, Ozden Turan, Ebru Ergenekon, Esin Koc, Yildiz Atalay. Are the neonatal outcomes similar in large for gestational age infants delivered by women with or without gestational diabetes. World J Pediatri 2012; 8(2):136-139
60. Oman Medical Journal 2008, Volume 23, Issue 1, January 2008. Profiles of Fetal Deaths
61. Emmanuel Odar, Julius Wandabwa and Paul Kiondo. Maternal and fetal outcome of gestational diabetes mellitus. Afr Health sci.2004 April; 4(1): 9-14. PMCID :PMC2141655
62. Bradley RJ, Brudenell JM, Nicolaides KH. Fetal acidosis and hyperlactinemia diagnosed by cardiocentesis in pregnancies complicated by maternal diabetes mellitus. Diabet Med 1991; 8: 464-468
63. Salfia CM. The fetal , placental and neonatal pathology associated with maternal diabetes. In :Reece EA, Coustan DR, eds. Diabetes mellitus in

pregnancy: Principles and practice. New York:Churchill Livingstone, 1998 :p.143-81
64. Girz BA, Diyon MY, Merkatz IR. Sudden fetal death in women with well-controlled, intensively monitored gestational diabetes. Perinatology 1992 Sep; 12(3): 229-33
65. IF Casson, CA Clarke, CV Howard, O McKendrick, POD Pharoah, S Walkinshaw – Outcome of pregnancy in insulin dependent diabetic women : results of a five year population cohort study, BMJ 1997, 315:275-278.
66. Mimouni F, Miodovnik M, Siddiqi TA, Berk MA, Wittekind C, Tsang RC: High spontaneous premature rupture labor in insulin dependent diabetic pregnant women : an association with poor glycemic control and urogenital infection. Obstet Gynecol, 1988; 72:175-180
67. Ray JG, O'Brien TE, Chan WS(2001) Preconceptional care and the risk of congenital anomalies in the offspring of women with diabetes mellitus: a meta- analysis. QJM 94:435-444
68. Patricia A. Janson, Ivan Rothman and Stephen M Schwatz, Congenital malformations in newborns of women with established and gestational diabetes, Paediatric and perinatal Epidemiology, Jan 1996, Vol 10, Issue 1 Pg 52-63.
69. Metzger BE, Lowe LP, Dyer AR, et al; Hyperglycemia and adverse pregnancy outcomes. N Engl J Med.2008 May 8:358(19):1991-2002
70. Langer O, Yd, Most O, Xenakis EM: Gestational diabetes: the consequences of not treating. Am J Obstet Gynecol 2005; 192:989-997
71. Crowther CA, Hiller JE, Moss JR, McPhee AJ, Jeffries WS, Robinson JS, Australian Carbohydrate Intolerance Study in pregnant women Trial Group. N Engl J Med, 2005 Jun 16; 352(24):2477-86
72. Sermer M, Naylor CD, Gare DJ et al. Impact of increasing carbohydrate intolerance on maternal- fetal outcome in 3637 women without gestational diabetes. The Toronto Ti- Hospital Gestational Diabetes Project. Am J Obstet Gynecol 1995; 173(1):146-156. PMID 7631672
73. Sacks DA, Chen W, Wolde- Tsadik G, Buchanan TA. Fasting plasma glucose test at the first prenatal screening tests in a high- risk population. J Reprod Med 2007; 52(4): 299-305. PMID 17506370
74. Nutrition Principles and Recommendations in diabetes, American Diabetic Association, Diabetic care 27, 2004: S76.
75. "Gestational Diabetes". Diabetes Mellitus & Pregnancy- Gestational Diabetes. Armenian Medical network. 2006. Retrieved 2006-11-27

76. Metzger BE, Coustan DR, Summary and recommendations of the fourth international workshop- conference on gestational diabetes mellitus, Diabetes care 1998: 21(Suppl 2):B 161-7
77. Taton J, Milicevik Z, Mozejko- Pastewka B, Bernas M, Czech A: How recombinant insulin analogs improve insulin therapy of diabetes mellitus: pathophysiology, clinical practice and recommendations. Med Sci Monit 7, 2001 : 848-859
78. Elliott BD, Langer O, Schenker S, Johnson RF: Insignificant transfer of glyburide occurs across the human placenta. Am J Obstet Gynecol, 1991; 165:807-812.
79. Agarwal MM, Dhatt GS. Fasting plasma glucose as a screening test for gestational diabetes mellitus. Arch Gynecol Obstet 2007; 275(2): 81-7. PMID 16967273
80. Catherine Kim, Diana K. Berger, Shadi Charmany. Recurrence of Gestational Diabetes Mellitus, Diabetes care May 2007 vol.30 no.5 1314-1319
81. Medical Eligibility Criteria for contraception use- World Health Organization,2004.
82. ACOG Practice Bulletin : The use of hormonal contraception in women with coexisting medical conditions. Int J Gynecol Obstet, 2001; 75:93-106.
83. Lee AJ, Hiscock RJ, Wein P, Walker SP, Permrzel M. Gestational diabetes mellitus: clinical predictors and long term risk of developing type 2 diabetes: a retrospective cohort study using survival analysis. Diabetes care. 2007; 30(4):878-83. PMID 17392549
84. Boney CM , Verma A, Tucker R, Vohr BR. Metabolic syndrome in childhood: associated with birth weight, maternal obesity and gestational diabetes mellitus. Pediatrics 2005; 115(3): E 290-6.PMID 15741354.
85. Yogev Y, Xenakis EM, Langer O. The association between preeclampsia and the severity of gestational diabetes: the impact of glycemic control. Am J Obstet Gynecol. 2004;191(5):1655-60.
86. Evers IM, de Valk HW, Visser GH : Risk of complications of pregnancy in women with diabetes: nationwide prospective study in netherland. BMJ, 2004; 328:915-919
87. Yogev Y, Ben-Haroush A, Chen R, Glickman H, Kaplan B, Hod M. Active induction management of labor for diabetic pregnancies at term; mode of delivery and fetal outcome--a single center experience. Eur J Obstet Gynecol Reprod Biol. 2004;114(2):166-70.

88. Priyanka Kalra, Chetan Prakash Kachhwaha, Hilda Victoria Singh. Prevalence of geatational diabetes mellitus and its outcome in western Rajasthan. Indian J E ndocrinol Metab.2013 Jul- Aug; 17(4): 677-80.PMCID: PMC 3743369

PROFORMA

PROFORMA

Name : Age : I.P.No.:

Address: SES : Ht:

Literacy: Wt:

G ravida Para Live

Abortion LMP EDD

Menstrual History :

DOA :

Marital History: DOD :

Obstetric History : Previous pregnancy

- H/O GDM in previous pregnancy
- Previous FTND or Previous LSCS

Present Pregnancy

- H/ O PIH

Past History :

Family History : Family history of diabetes mellitus.

GENERAL EXAMINATION

Built & Nourishment Ht :

Pallor Wt :

Pedal edema BMI :

CVS & RS

P/A

INVESTIGATIONS

Hb%

Urine : Alb

Sugar

Deposits

Glucose challenge test (GCT) : In 1st , 2nd and 3rd trimester (diagnosis of GDM done in which trimester)

Blood sugar levels

Blood sugar levels	At time of diagnosis	In 2nd trimester	In 3rd trimester
FBS			
PPBS			

USG

GDM treatment

- On meal plan
- On insulin and meal plan
- Meal plan converted to insulin
- Insulin converted to meal plan

Maternal factors

Mode of delivery

- Labour natural
- Instrumental delivery
- LSCS
- Repeat LSCS

Caesarean section : Indication

NEONATAL OUTCOMES

- Macrosomia
- Hypoglycemia
- Hyperbilirubinemia
- Anomaly
- Stillbirth
- Perinatal mortality
- Respiratory distress syndrome
- Seizures
- NICU admission
- IUD
- Perinatal injury

ABBREVIATIONS

ABBREVIATIONS

GDM - Gestational Diabetes Mellitus

NICU - Neonatal Intensive Care Unit

IUD - Intra Uterine Death

ADA - American Diabetic Association

FBS - Fasting Blood Sugar

PPBS - Post Prandial Blood sugar

ACOG - American College of Obstetrics and Gynaecology

PIH - Pregnancy Induced Hypertension

WHO - World Health Organization

Hb - Hemoglobin

GLUT - Glucose Transporters

UTI - Urinary Tract Infection

GCT - Glucose Challenge Test

OGTT - Oral Glucose Tolerance Test

RDS - Respiratory Distress Syndrome

TTN - Transient Tachypnea of Newborn

FDA - Food and Drug Administration

IUCD - Intra Uterine Device

COC - Combined Oral Contraceptives

MNT - Medical Nutrition Therapy

CVS - Cardio Vascular System

CNS - Central Nervous System

RS - Respiratory System

BMI - Body Mass Index

PROM - Pre labor Rupture Of Membrane

LSCS - Lower Segment Caesarean Section

CPD - Cephalo Pelvic Disproportion

FTND - Full Term Normal Delivery

LMP - Last Menstrual Period

EDD - Expected Date of Delivery

DOA - Date Of Admission

DOD - Date Of Delivery

SES - Socio Economic Status

USG - Ultra Sono Gram

Ht - Height

Wt - Weight

P/A - Per Abdomen

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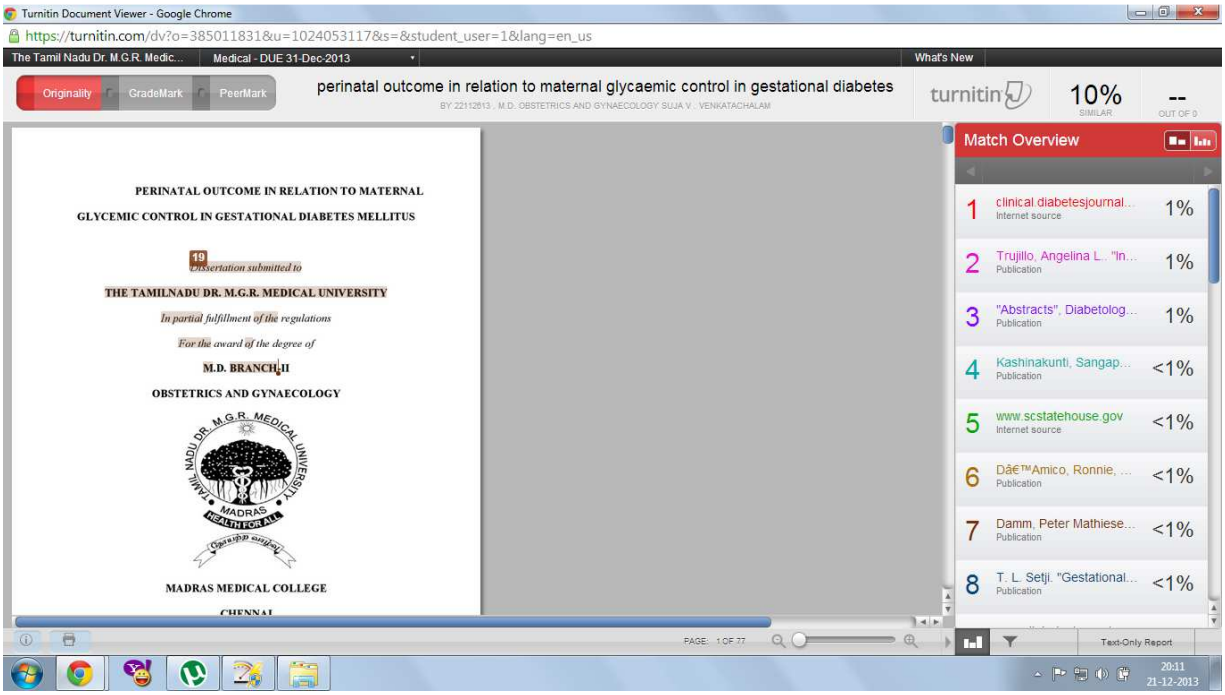
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PERINATAL OUTCOME IN RELATION TO MATERNAL GLYCEMIC CONTROL IN GESTATIONAL DIABETES MELLITUS Dissertation submitted to THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY In partial fulfillment of the regulations For the award of the degree of M.D. BRANCH-II OBSTETRICS AND GYNAECOLOGY MADRAS MEDICAL COLLEGE CHENNAI APRIL 2014 INTRODUCTION Pregnancy is a condition where the metabolic adaptations occur to accommodate rapidly growing tissue transplant ,conceptus. Placenta, new organ arises de novo during the pregnancy, develops and matures till it is expelled at the completion of gestation. The conceptus for its own normal development causes alteration in the maternal metabolism characterized by...