Preeclampsia and gestational diabetes mellitus(GDM) diagnosis in pregnant women

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Abstract

During their term of pregnancy, women may develop symptoms characterized by high blood pressure and signs of damage to another organ system, most often the liver and kidneys. This condition is known as Preeclampsia. According to the Centers for Disease Control and Prevention, it's estimated to occur in up to 9.2 percent of pregnancies. Preeclampsia is often precluded by gestational hypertension. The signs of preeclampsia usually start showing at a relatively advanced stage in pregnancy (late second to early third trimester). However, the disorder results from abnormal interaction between fetal and maternal tissue much earlier in pregnancy, between 8 and 18 weeks' gestation. Hence, early diagnosis of Preeclampsia and Gestational Diabetes would prove beneficial for pregnant women to prevent the progression of the disease. Through our research, we aim to diagnose Preeclampsia and gestational diabetes mellitus(GDM) in pregnant women by using Deep Learning techniques. More research examining treatment and the long-term implications of this condition among women with pre existing and diabetes is required to effectively solve this issue.

Introduction and motivation

Preeclampsia (preE) is a pregnancy complicated resulting due to the de novo development of hypertension and proteinuria after twenty weeks of gestation. It is the most common cause of maternal and foetal morbidity and mortality. Over 20% of the diabetic women who become pregnant develop preE. Excessive glucose circulating in the blood stream, mostly caused by Diabetes (may or may not be gestational), is one recognised precursor of preE.

GDM and preE both pose high risk to mother and child. This risk increases with higher blood glucose levels. The two main risks GDM imposes on the baby are growth abnormalities and chemical imbalances after birth.

For the mother, if preeclampsia is not treated quickly and properly, it can lead to serious complications such as liver or renal failure and future cardiovascular issues. It may also lead to fatal conditions like Eclampsia(leading to seizures in the mother) and HELLP Syndrome (hemolysis, elevated liver enzymes, and low platelet count).

And for the baby, it can prevent the placenta from getting enough blood. If the placenta doesn't get enough blood, the baby gets less oxygen and food. This can result in low birth weight and several life-threatening complications in the future as well.

Treatment resulting in better control of these levels can reduce some of the risks of GDM considerably. Early prediction of Gestational Diabetes and pre-eclampsia would allow for timely initiation of preventive therapy and further better treatment resulting in saving two lives.

We aim to develop a system that diagnoses GDM and preE effectively through use of neural networks thereby enabling early therapy measures for pregnant women.

Background:

For our health trek visit, we chose one of the most renowned medical college of the nation, Smt Sucheta Kriplani Hospital, better known as Lady Hardinge Medical College. It is a government hospital, ranked as the seventh best hospital, across the nation. The doctors, here strive to provide the best services, with the least of facilities and infrastructure. Since the medical services at the government hospitals are free of cost, it makes its outreach even towards the less privileged class of the society. There are different departments to address the needs of patients, with the renowned gynaecology department. During our visit, we observed that the number of people waiting for their turn to be diagnosed were huge, and the awareness amongst the patients was alarmingly low.

Lady Hardinge Statue in the Medical College premises

Experiences of the interaction

If given an opportunity to describe the experience of the interaction in one word it will surely be thrilling. It provided us an opportunity to directly address the problems faced by the people directly and brainstorm about the ideas, which we can implement to help people. As a team, this was the collective idea that the gap between developers and the idea which is to be implemented, can only be curbed with the interactions, we have with the end users.

For our interaction, we met Ishmeet, who is currently studying at the Medical college, we discussed with her the kind of target users we were looking for as we aimed to work in order to provide better diagnosis system, as the regular monitoring during such conditions are difficult. In order to know the intricacies of the process which the doctors undertook, we met Dr. Raksha, with whom we discussed the tests and the monitoring which are required during the pregnancy period and directed our research in the topics which we found interesting for our research.

Our team (Saloni, Akshama, Srishti) interacting with Dr. Raksha

Interacting with Ishmeet, an MBBS student at Lady Hardinge Medical College

<u>Questionnaire and Analysis</u>

Q. What are the various diagnostic schemes undertook during pregnancy?

A: Dr. Raksha discussed about the four sittings that usually the pregnant ladies undergo, in which they majorly do the following tests:

1. UltraSound
2. HIV test
3. Thalassemia
4. Hypertension
5. Blood sugar test

After discussing all the above tests. We found the last two topics as the point of interest thus, are including the relevant discussion depending upon the topic which we'll be working on during the hackathon.

Visiting various wards in the hospital

Q: What is the present method that is being used in your Hospital for diagnosing Preeclampsia and gestational diabetes mellitus(GDM) in pregnant women ?

A:

Oral Glucose Tolerance Test (OGTT)- For Diagnosing GDM

It has been recommended that a 2-h 75-g OGTT be performed on all women at 24 to 28 weeks' gestation not previously found to have Gestational Diabetes Mellitus (GDM) during early testing in their current pregnancy.

Antenatal checkup- For Diagnosing Preeclampsia

Early diagnosis and treatment of Preeclampsia is done through regular antenatal checkup, wherein persistent high blood pressure and weight of patient indicate that the diagnosis is positive.

LHMC Hospital follows standard guidelines and procedures that are being followed globally.

Q: Can you please describe those methods?

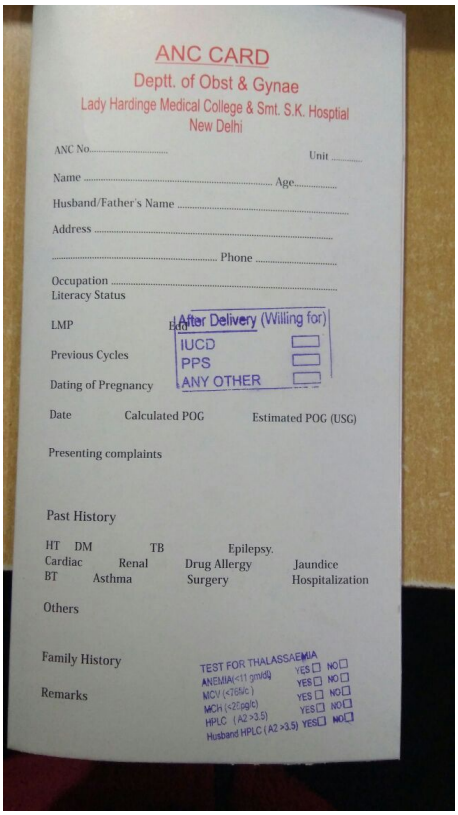
A:

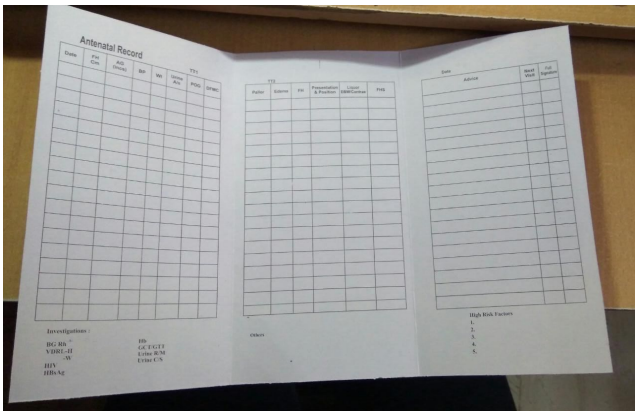
The OGTT test should be done in the morning after an overnight fast of 8 - 14 hours and after at least 3 days of unrestricted diet (>150 grams carbohydrates per day) and unlimited physical activity.

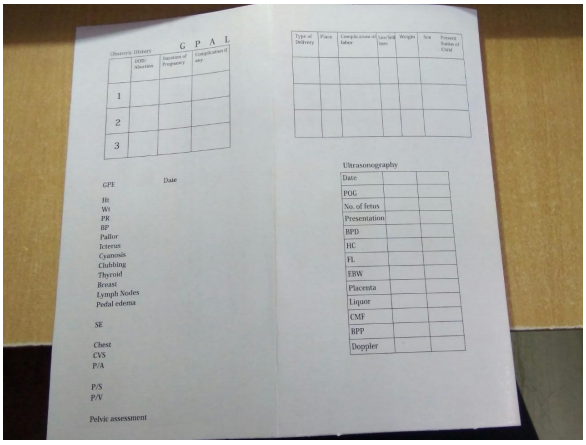
One or more of the values from a 75-g OGTT must be equaled or exceeded for the diagnosis of GDM.

The patient needs to go to the lab one time for a 2-hour glucose tolerance test. For this test:

- One should not eat or drink anything (other than sips of water) for 8 to 14 hours before the test. (One also cannot eat during the test.)
- The patient will be asked to drink a liquid that contains glucose (75 g).
- The patient will have blood drawn before you drink the liquid, and again 2 more times every 60 minutes after you drink it. Each time, your blood glucose level will be checked.
- Allow at least 2 hours for this test.







The Antenatal Card used for diagnosing disorders during Pregnancy

In tabular form :

2 hour 75-g Oral Glucose Tolerance Test, OGTT, GTT (plasma)

Units	Fasting	1 hour	2 hour
mg/dL	92	180	153
mmol/L	5.1	10	8.5

Preeclampsia is a pregnancy specific hypertensive disease with multisystem involvement. It is a disorder of widespread vascular endothelial malfunction and vasospasm that occurs after 20 weeks of gestation and can present as late as 4-6 weeks postpartum (after child birth).

Classification of hypertension in pregnancy:

Preeclampsia

Hypertension developing after 20 weeks' gestation with proteinuria and/or edema.

Gestational hypertension

Hypertension developing after 20 weeks' gestation without other signs of preeclampsia.

Chronic hypertension

Hypertension before 20 weeks' gestation in the absence of neoplastic trophoblastic disease.

Preeclampsia is diagnosed by persistent high blood pressure that develops during pregnancy or during the postpartum period and is associated with a lot of protein in the urine or the new development of decreased blood platelets, changes in the kidney or liver function, fluid in the lungs, or signs of brain disorder such as seizures and/or visual disturbances.
The diagrams, in this journal, indicate all the parameters that are tested in the Antenatal checkup.

Diagnostic criteria

A pregnant women having an average reading of systolic blood pressure (SBP) of more than/equal to 140 mmHg and/or diastolic blood pressure (DBP) of more than/equal to 90 mmHg was considered as hypertensive (DBP ≥90 mmHg and/or SBP ≥140 mmHg).

Q: What drawbacks does this method suffer from due to which the efficiency is hampered?
A:

The entire duration of pregnancy, requires one to take extreme care of oneself. Hypertension and Diabetes are complex diseases, whose successful management requires a comprehensive approach. To acquire the necessary self-management skills, a pregnant woman requires a team comprised of a knowledgeable physician, professional diabetes educators, and a caring support system. However, in India a large population of pregnant women are from rural background and have limited access to health and sanitation

facilities. If a reliable system for diagnosing Preeclampsia and GDM can be made, it could very useful for the underprivileged population of our country . Moreover, proper guidance at an earlier stage can help them to be successful in mastering the skills and making the lifestyle changes necessary to achieve optimum control of their disease.

Problem identified

Preeclampsia and GDM affects approximately 1-14% of all pregnancy leading to many maternal and fetal problems. Early detection and treatment of these conditions may reduce the health complications in pregnancy outcome. We observed that the current diagnostic system, followed in the hospital that we visited, obtains its results by the clinical tests done at the place itself. It does not take into account the past history of the patient's visits, the test results of similar aged patients and patients having other parameters as similar. Through our deep learning approach, we want to increase the reliability of this diagnostic procedure and help doctors in their decision- making process. Our technique aims for early diagnosis of Preeclampsia and Gestational Diabetes that would prove beneficial for pregnant women to prevent the progression of the disease.