# EFFECT OF ANTENATAL CORTICOSTEROIDS ON MATERNAL BLOOD GLUCOSE LEVELS

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## ABSTRACT

**Objective:** To study the effect of antenatal corticosteroids on maternal blood glucose levels.

**Methodology:** This observational study was conducted in the Department of Obstetrics and Gynecology at Hayatabad Medical Complex, Peshawar, after obtaining ethical approval from the Institutional Ethical Review Board. All patients admitted to the labor suite for antenatal corticosteroids were included in the study, while patients with diabetes or any other medical disorder requiring corticosteroids were excluded. Patients were selected using a non-probability convenient sampling technique. They were given two doses of Betamethasone (12mg) intramuscularly, with a 24-hour interval between doses. Maternal blood sugar levels were checked before administering the first dose of Betamethasone. Subsequently, patients were placed on a sugar profile for five days. All the data were entered in a pre-designed proforma.

**Result:** A total of 247 patients were included in the study. The majority of the patients were multigravida (50.20%) and belonged to the age group of 21-30 (50.20%). The mean age of the patients was 26.4 ± 2.3 years. The majority of the patients (72.46%) had deranged blood sugar levels, either falling within the range of impaired glucose levels or full-blown diabetes. Antenatal corticosteroids mainly affected fasting blood sugar (FBS) and post-prandial blood sugar levels.

**Conclusion:** Antenatal corticosteroids administered to normoglycemic patients result in significant but transient hyperglycemia. However, in the majority of patients, blood sugar levels normalize within five days following the administration of corticosteroid doses.

**Keywords:** Antenatal; Corticosteroids, Blood Sugar, Betamethasone

## INTRODUCTION

Corticosteroids are anti-inflammatory drugs used in different medical disorders. Glucocorticoids increases proteolysis, lipolysis and hepatic glucose production by providing a substrate for oxidative stress metabolism.[1] Like type 2 diabetes steroids also increase insulin resistance, the glucose intolerance may be up to 60%-80% depending on the dose and type of steroid used.[2] Because of the wide range of side effects, the use of steroids is limited despite their efficacy. One of its side effects is that it causes hyperglycemia. Steroids are one of the most important causes of drug-induced hyperglycemia.[3] Facilitated diffusion is required for the maternal blood glucose to cross the placenta. High maternal blood glucose will lead to fetal hyperglycemia which will then stimulate increased fetal insulin secretion leading indirectly to neonatal hypoglycaemia.[4] Different studies have shown an association between maternal hyperglycemia and neonatal hypoglycaemia.[5,6]

In 1995 National Institutes of Health (NIH) Consensus Development Conference statement recommended Antenatal corticosteroids for the first time during pregnancy.[7]

Both Royal College of Obstetricians and Gynecologists (RCOG) and American College of Obstetricians and Gynecologists (ACOG) recommend antenatal corticosteroids (either betamethasone or dexamethasone) to accelerate fetal lung maturity in premature babies.[8,9] Use of glucocorticoids in preterm labour can prevent respiratory distress and decreases the incidence of hyaline membrane disease in the premature neonates. Use of glucocorticoids lead to increase in alveolar surfactant level and improve pulmonary compliance by stimulating type type II cells in the fetal lungs.[8,10]

In antenatal patients steroids lead to transient hyperglycemia due to its diabetogenic potential even in non-diabetic pregnant women because pregnancy itself leads to obvious insulin resistance. The duration of persistence of hyperglycemia will depend on the half-lives of the glucocorticoid used; i.e. 5.5 hours for

dexamethasone and 11 hours for betamethasone.[9,11] Large amount of glucose given to antenatal patients before elective caesarean section even in non-diabetic patients led to maternal hyperglycemia and subsequently neonatal hypoglycaemia.[12] In a recent systematic review in women with diabetes an association has been documented between maternal hyperglycemia and neonatal hypoglycemia.[6]

Glucocorticoids increase the insulin resistance by inhibiting glucose uptake and decreasing its storage. The glycemic effect of steroids usually start about 12 hours after the first dose and last for up to 5 days after the last dose. In some studies it have been documented that the effect of steroids on blood sugar level in non-diabetic women lasts 24 hours.[10] It has been well documented that the long-term use of glucocorticoid led to increase in the risk of diabetes but the effect of short duration of corticosteroids use on glucose metabolism is less reported in the literature, particularly in antenatal women who are already having increased risk of glucose intolerance.[6,10]

We have selected this topic because of the scarcity of the literature especially in our local setup regarding the effect of antenatal steroids on maternal glucose levels.

## METHODOLOGY

This observational study was conducted in the department of Obstetrics and Gynecology, Hayatabad Medical Complex, Peshawar from January 2022 to December 2022, after ethical approval from the Institutional ethical review board. All patients admitted in the labour suit for antenatal corticosteroids were included in the study. While patients having diabetes (either gestational or pre gestational) or any other medical disorder requiring corticosteroids were excluded from the study.

Patients were selected through non probability convenient sampling technique after informed written consent. Patients were given 2 doses of Betamethasone (12mg) intramuscular 24hrs apart (according to the RCOG guidelines).[9] Maternal blood sugar levels were checked before giving 1st dose of Betamethasone. Patients were then put on sugar profile including Fasting blood sugar (FBS), 2hr post lunch and 2hr post dinner for 5 days. FBS >95mg/dl and random blood sugar (RBS) >140mg/dl were considered as abnormal. Patients were then classified as euglycemic, transient hyperglycemic, impaired glucose levels and gestational diabetics. Patients having normal blood glucose levels for 48hrs were labeled as euglycemic while those having deranged blood sugar initially but which then normalizes within 5days were labeled as having transient hyperglycemia. Patients having random blood sugar levels ≥200mg/dl or fasting blood sugar ≥126mg/dl were considered as Gestational Diabetics.

Patients whose random blood sugar levels were between >140 - 199mg/dl or FBS >100-125mg/dl for 5 days were classified as having impaired glucose levels[6,9]. All the data were entered in a predesigned proforma. Descriptive statistics including frequencies and percentages were used for data analyses using SPSS vs. 20.

## RESULTS

A total of 261 patients were included in the study, out of which 14 were excluded as either they got delivered earlier than 5 days or their blood sugar record were not properly maintained. Most of the patients were multigravida (50.20%) in the age group between 21-30 years (50.20%). The mean age of the patients was 26.4± 2.3 years (Table No 1). The majority of the patients (72.46%) were having deranged blood sugar level either in the impaired/full blown diabetes range (Table No 2). Mainly FBS and post-prandial were affected by antenatal corticosteroids (Table No 3). Out of 140 patients having blood sugar levels in the range of diabetes 14 (5.66%) were started on insulin due to high blood sugar levels while 126 (51.01%) were having transient hyperglycemia.

## DISCUSSION

In our study 72.46% cases were having deranged blood sugar levels. On day 5, FBS was deranged in 5.66% cases, post lunch in 1.21% cases and post dinner was deranged in 4.04% cases. Patients belonging to South Asian ethnicity are at increased risk factor of developing gestational diabetes. In Pakistan antenatal patients are not routinely screened for GDM. Steroid causes increased insulin resistance mainly by inhibiting glucose uptake and storage. Insulin resistance gradually increases during pregnancy with maximum resistance occurring during third trimester of pregnancy.[11]

In our study 47.77% women were having deranged FBS on day one; it then declined to 5.66% on day 5. Renuka et al have documented significant blood sugar level variation during antenatal corticosteroid administration with p value of 0.00 and this increase in FBS persisted up to 6$^{th}$ day. After betamethasone administration, in 84% patients FBS levels started rising from day. After this initial rise in FBS, it started declining with only 56% patients having high FBS on day 3 and 4 and 74% had normal FBS on day 6. Only 26% had high FBS levels even on 6$^{th}$ day, out of which 44 patients were normoglycaemic before steroid therapy and 14 patients were pre diabetic.[13]

Similarly postprandial blood sugar (PPBS) levels rises after betamethasone administration. In our study almost 75.7% women had elevated postprandial blood sugar level. There was a gradual decrease in the blood sugar levels over day 2, 3 and 4, but still 5.25% were having elevated blood sugar

Table 1: Demographic details of the sample (n= 247)

| Variables | | Frequency(Percentages) |
|---|---|---|
| Age(years) | ≤20 | 35 (14.17%) |
| | 21- 30 | 124 (50.20%) |
| | >30 | 88 (35.62%) |
| Gravidity | Primigravida | 70 (28.34%) |
| | Multigravida | 124 (50.20%) |
| | Grand multigravida | 53 (21.45%) |

Table 2: Distribution of cases according to blood sugar level (n= 247)

| Variables | Frequencies (percentages) |
|---|---|
| Normal blood sugar values | 68 (27.53%) |
| Deranged blood sugar values | 179 (72.46%) |
| Impaired blood sugar levels | 39 (15.78%) |
| Blood sugar levels in range of full blown diabetes | 140 (56.68%) |

Table 3: Distribution of cases according to elevated blood glucose levels during 5 days (n= 247)

| Variables | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 |
|---|---|---|---|---|---|
| FBS | 118 (47.77%) | 108(43.72%) | 108(43.72%) | 59 (23.88%) | 14 (5.66%) |
| Pre Lunch | 49 (19.83%) | 69 (27.93%) | 10 (4.04%) | 0% | 0% |
| Post Lunch | 79 (31.98%) | 79 (31.98%) | 29 (11.74%) | 8 (3.23%) | 3 (1.21%) |
| Predinner | 89 (36.03%) | 40 (16.19%) | 10 (4.04%) | 10 (4.04%) | 0% |
| Post Dinner | 108 (43.72%) | 20 (8.09%) | 10 (4.04%) | 10 (4.04%) | 10 (4.04%) |

level on day 5.Renuka et al has also documented that antenatal steroids affect the PPBS. On day 2 of steroid dose about 87.3 % patients were having raised blood sugar levels, while on day 3 and 4 PPBS started declining, with 46% having normal blood sugar levels, and on day 6 about 80 % patients were having normal PPBS. Only 20% patients were having raised blood sugar levels even on day 6, out of which around 30 patients were normoglycaemic before steroid while 14 patients were already diabetic. The percentage of cases that had increased FBS levels on day 6 was more than PPBS levels, similar results were observed in our study with FBS (11.74%) more than PPBS (5.25%).[13]

Beena et al has documented that overall 65% of the patients were having elevated FBS > 90mg/dL on D2 and on third day 10 new cases were added. Similarly on Day 2, about 66% women were having post prandial blood sugar levels >120mg/dl and on Day 3 almost 13 new cases were added. In Group1 (normoglycaemic patients) FBS was high in 59.6% cases on day 2 and in 57.7% the readings were high on day 3 and the level of blood sugar gradually declined on days 4, 5 and 6. Similar trend was seen in post prandial blood sugar values with 59.6% having elevated PPBS on D2, while 52.9% on D3 showed elevated levels.[14] In the study conducted by Beena et al 62.9% of normoglycaemic patients required insulin after antenatal corticosteroid administration. In the GDM patients who were on the medical nutritional therapy (MNT), 33 out 40 women were also started on insulin. While patients who were already on insulin, about 47% increase in the insulin doses was required to overcome the insulin resistance.[14] In our study 14 (5.66%) patients required insulin due to high blood sugar levels. The difference may be because of the difference in the study group and the target blood sugar level for starting insulin.

In a local study conducted by Naheed S et al it has been documented that 73.78% of study participants had impaired blood sugar level after steroid therapy, out of which 67.51% had transient hyperglycemia whereas 6.21 % developed GDM.[15] In our study 51.01% were having transient hyperglycemia while in 5.66% insulin was started due to high blood sugar levels.

Fernandes SF et al in their study have documented that FBS was elevated in 54.65% on day 2 in the normoglycaemic patients after antenatal steroids and this decreased to 29.53% on Day 4 and 19.76% on Day 5. Similarly, PPBS was elevated in 54.65% cases on day 2 of antenatal corticosteroids and reduced to 26.7% and 13.95% on day 4 and day 5 respectively.[16] In our study FBS and RBS levels were raised at 24hrs and then gradually declined to baseline. Similar results were also shown by other studies.[17-19]

It has been reported in a review article that blood sugar level must be checked before giving steroid. And patient should be monitored in the hospital for at least 5 days for fetomaternal surveillance. How robust the blood sugar levels should be monitored will depend on the nature of diabetes. To decrease the negative impact of hyperglycemia upon fetomaternal outcome, insulin initiation or increase in the dose of insulin may be required.[6] Similar results were also shown by other studies, documenting the need of insulin for significant hyperglycemia after antenatal corticosteroid.[20,21]

## CONCLUSION

Antenatal corticosteroids in normoglycaemic patients lead to significant but transient hyperglycaemia. In most of the patients' blood sugar normalizes within 5 days of corticosteroid doses.

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## Author's Contribution

RK and SAS conceived the idea, collected the data and analysed the data and drafted the manuscript. RA helped in designing the study and performed the data analysis and checked the manuscript for technical issues. SS contributed in designing the study and critical revision of the manuscript. Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

## Conflict of Interest

Authors declared no conflict of interest

## Grant Support and Financial Disclosure

None

## Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.