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Original Research Article

Erythrocyte profile in cordblood of newborns to diabetic and non-diabetic mothers

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ABSTRACT

Background: Diabetes, an endocrinal disorder causing morbidity and mortality has its effect on gestational diabetes. Intrapartum stress, maternal hyperglycemia leads to fetal hyperglycemia. The maternal glycaemic status has influence on neonates erythrocyte profile.
Methods: Cord blood of neonates born to 40 diabetic (known to be diabetic at pregnancy) and 40 non-diabetic mothers were selected. A fully automated hematology analyzer ABXMICROsot was used to analyze whole blood collected in EDTA tubes. The diabetic group was subdivided into D1 and D2. D1 as 100-150 mg/dcl, D2 as above 150 mg/dcl.
Results: Hemoglobin, hematocrit, MCV, MCH, RDW were significantly higher, RBC count were comparatively insignificant. Hemoglobin (Hb), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), Mean corpuscular hemoglobin concentration (MCHC) were significantly higher in D2 than D1 group. The prognosis for the child of a pregnant diabetic is related to the degree of control of mother's glycemic status, reflected as higher indices in D2 than D1.
Conclusions: Neonatal immune system depends on maternal immune system i.e, all the immunological properties are practically under the control of interleukin-1 and interleukin-6. Interleukin-6 potentiates the action of interleukin-1 synergistically, such action of interleukin converts noncommitted stem cells to committed stem cells. Immunosuppressant status in diabetic mother (i.e., non-priming of neonatal interleukin-6 by immunosuppressant diabetic mother`s interleukin-6, the main cause for these altered count). By modulating neonatal interleukin-6 it decreases hematopoietic potential in the neonates, on the other hand ECF in infants of diabetic mother is reduced leading to hemoconcentration and increase in cell counts. Giving a picture as if polycythemia at birth in neonates of diabetic mothers.

Keywords: Gestational diabetes, Cord blood, Interleukin, Immunity, Neonates, Haematological indices

INTRODUCTION

Gestational diabetes mellitus is defined as diabetic mellitus appearing for the first time in pregnancy or could be associated with potential diabetes. In diabetes maternal hyperglycemia leads to fetal hyperglycemia which in turn stimulates the fetal beta cells to increase insulin production. Fetal insulin has central role in fetal growth and development during approximately the last 10 weeks of gestation.

The grouping of diabetic mothers according to blood sugar levels gave more information of prognostic importance. All the immunological properties are practically under the control of interleukin-1 and interleukin-6, consequently the defense capability of neonates in the new hostile

environment is influenced by immunomodulatory status of interleukin-1 and interleukin-6 of diabetic mothers.

Thus, in this study, we made an attempt to document data regarding erythrocyte profile in cord blood samples of neonates to diabetic and non-diabetic mothers. In this local cross section of population we also observed influence of maternal hyperglycemia on erythrocyte profile of new born.

METHODS

Study type

Prospective case-control study.

Study place

Vanivilas hospital at Bengaluru, India.

Study period

From January 2000 to March 2002.

Selection criteria of patient

Pregnant women's visiting obstetric department of vanivilas hospital for pre-natal checkup were screened for blood glucose levels, mean blood glucose level during the last weeks of pregnancy was calculated for each women and used as index of glycemic status of pregnant women's.[2] The diabetic group was subdivided into D1 i.e., mother`s sugar level before the birth of neonates 100-150 mg/dl and D2 i.e., sugar level above 150 mg/dl.

Diabetic mothers with vascular complications like benign retinopathy, proliferative retinopathy and nephropathy were excluded. Control group consisted of uncomplicated pregnant women.

Ethical approval was obtained from OBG department and peadeatric department of vanivilas hospital.

After resection of the umbilical cord, the cord stem remaining on the placenta was cleared off the maternal blood, 2 ml of cord blood was collected with EDTA as anti-coagulant. The sample was transferred to the laboratory in a cold container and analyzed using ABXMICROsot, a fully automated hematologic analyzer was used for in-vitro diagnostic testing of whole blood specimens.[3] The following parameters were recorded by using 12 micro liters of whole blood mixed with Ethylenediamine tetraacetic acid (EDTA). The parameters are red blood cells (RBC), hemoglobin (HgB), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW). The data obtained from cord blood sample of new borns to 40 diabetic and 40 non-diabetics was documented.

It was found that the hemoglobin, hematocrit, MCV and MCH were significantly higher but RBC count were comparatively insignificant. There is a significant increase of RDW in neonates of diabetic group reflecting increased anisocytosis due to the presence of reticulocyte and progenitors of erythroid series. It was evident that HB, HCT, MCV, MCH, MCHC, RDW are significantly higher in D2 than D1 group. The prognosis for the child of a pregnant diabetic is related to the degree of control of mother's glycemic status1 which is reflected by higher indices in D2 than D1.

RESULTS

The sample of 80 subjects comprised of 40 diabetic and 40 non-diabetic pregnant women constituting a representational cross section of the local population. The cord blood sample was analyzed using automated hematological analyzer.

Table 1: Mean, SD and level of significance of cord blood erythrocyte profile in neonates of non-diabetic and diabetic mothers.

Parameters	Non-diabetic		Diabetic		t value	Significance
	Mean	SD	Mean	SD		
RBC $10^6/mm^3$	4.6678	0.3417	4.5577	0.4545	1.223	NS
HGB gm/dl	14.8675	1.4291	16.0925	1.5705	3.649	S
HCT%	48.7300	4.3711	51.3925	5.1360	2.497	S
MCV m^3	104.4000	5.2124	113.3750	11.1394	4.615	S
MCH Pgm	31.8600	1.9878	35.5850	4.1378	5.132	S
MCHC g/dl	30.2325	1.5907	31.3425	0.9714	3.767	S
RDW%	14.4900	0.6819	16.5300	1.4483	8.060	S

RBC- red blood cells; HGB- hemoglobin; HCT- hematocrit; MCV- mean corpusculuar volume; MCH- mean corpuscular heamoglobin; MCHC- mean corpuscular heamoglbin concentration; RDW- red cell distribution width

Table 2: Mean, SD and level of significance of cord blood erythrocyte profile in neonates of D1 and D2 group mothers.

Parameters	Diabetic-1		Diabetic-2		t value	Significance
	Mean	SD	Mean	SD		
RBC 10^6/mm^3	4.5271	0.1217	4.5916	0.6548	0.422	NS
HGB gm/dl	15.5857	1.6886	16.6526	1.2429	2.255	S
HCT%	50.1571	4.8915	52.7579	5.1788	2.307	S
MCV m^3	111.1429	10.4942	115.8421	11.5861	3.417	S
MCH Pgm	34.5667	3.8120	36.7105	4.2899	2.102	S
MCHC g/dl	31.0524	0.8214	332.6632	1.0431	2.043	S
RDW%	16.1238	0.8185	17.9789	1.8426	2.863	S

RBC- red blood cells; HGB- hemoglobin; HCT- hematocrit; MCV- mean corpusculuar volume; MCH- mean corpuscular heamoglbin; MCHC- mean corpuscular heamoglbin concentration; RDW- red cell distribution width.

The diabetic group was subdivided into D1 i.e., mother`s sugar level before the birth of neonates 100-150 mg/dl and D2 i.e., sugar level above 150 mg/dl. The data so obtained relating to erythrocytes was statistically analyzed and documented.

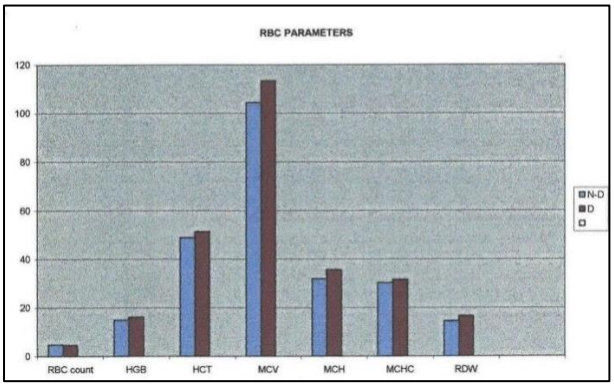

Figure 1: Cord blood erythrocytic profile in neonates of nondiabetic and diabetic mothers.

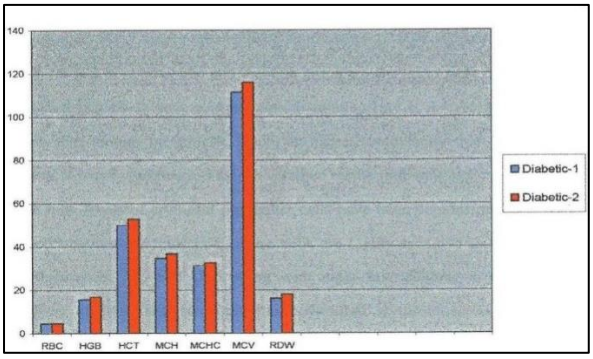

Figure 2: Cord blood erythrocytic profile in neonates of diabetic-1 and diabetic-2 groups of mothers.

It was found that the hemoglobin, hematocrit, MCV, MCH, RDW were significantly higher but RBC count were comparatively insignificant in cord blood of neonates to diabetic mother. It was evident that HB, HCT, MCV, MCH, MCHC, RDW are significantly higher in D2 than D1 group. The prognosis for the child of a pregnant diabetic is related to the degree of control of mother's glycemic status which is reflected by higher indices in D2 than D1.[1]

DISCUSSION

An attempt was made to discuss impact of glycemic level on various parameters.

Erythrocyte profile

The RBC parameters related with respect to diabetic and non-diabetic group are shown in table 1 and 2 and bar diagram figure 1 and 2. It is evident from table 1 that, though mean RBC count is higher in non-diabetic than diabetic group but it is not significant.

This is explained by the following way: high level of erythroid progenitor cells have been demonstrated in fresh blood obtained by fetouscope, these cells are highly sensitive to stimuli like erythropoietin but interleukin-6 along with other interleukins is required to convert uncommitted stem cells to committed erythroid series on which erythropoietin can act to enhance erythropoiesis.[4,5] The interleukin-6 of neonates in diabetic group losses it's hemopoetic potency to do the same due to immunomodulatory effect of diabetic mothers interleukin-6.[6] This resulting in decreased enhancement of RBC count. The effect is balanced by extramedulary erythropoesis due to acute and chronic hypoxic episodes brought about by placental abnormality, and hemoconcentration due to decreased ECF volume. These 2 factors have balanced less potent interleukin-6 effect of decreasing the count and bring about polycythemia in diabetic group.[7,8]

It's evident from table 1 and figure 1 that Hb, HCT, MCV, MCH and MCHC are significantly higher in diabetic group than non-diabetic group which is substantiated as the type

of Hb during intra uterine life as fetal Hb having 2 alpha and 2 gamma chains. This type of Hb is suitable to meet the oxygen demand of fetus in intra uterine environment. However slowly and steadily HbF switches over to HbA type. The presence of hyperinsulinamia in the fetus of diabetic mother activates dormanting genes and continues the synthesis of HbF so the amount of HbF in 38-40 weeks old fetus of diabetic mother is equal to about in 28-30 weeks old fetus of non diabetic mother. Thus, delayed switch over from HbF to HbA due to hyperinsulinimea gives rise to significant increase in Hb content in cord blood of neonates to diabetic mother.

There is a significant increase of RDW in neonates of diabetic group reflecting increased anisocytosis due to the presence of reticulocyte and progenitors of erythroid series on account of extramedularly erythropoesis arising due to hypoxic episodes brought by placental abnormalities.[7,8]

The presence of reticulocyte and progenitors give rise to increase MCV, this give rise to increase hematocrit, the high values for Hb and PCV immediately at birth are somewhat misleading giving the impression that polycythemia is present. Instead macrocyte and HbF contents are responsible.

The hematocrit and Hb% are the resultant of MCV, type of Hb and its content of cells.[9] However perinatal stress and hypoxia induced due to placental abnormalities increased cord blood erythropoietin giving rise to polycythemia in first week of neonatal period. As shown in table 2 its evident that though mean RBC count is higher in D2 group than in D1 group is not significant as the cells are highly sensitive to stimuli like erythropoietin i.e., extramedullary erythropoesis due to hypoxia induced by placental abnormality and hemoconcentration due to decreased ECF volume which together tend to give rise to an increase.[1,4,8] These two factors have not brought out the significant effect of decreasing the count and thereby have not increased the RBC count between two diabetic groups.

It is evident from table 2 that Hb, HCT, MCV, MCH, MCHC are significantly higher in D2 than D1 group. The prognosis for the child of a pregnant diabetic is related to the degree of control of mother`s glycemic status which is reflected by higher indices in D2 than D1.[1]

There is a significant increase of RDW in neonates of D2 group reflecting increased anisocytosis, due to the presence of reticulocytes and precursor of erythroid series on account of extramedullary erythropoeisis arising due to hypoxic episodes brought about by placental abnormalities. The presence of reticulocytes and other progenitors give rise to increased MCV. This gives rise to increased hematocrit. Thus, the D2 and D1 groups reflect the effect of glycemic status of mother. As the child prognosis depends on the glycemic status of mother at birth.

In this study the values fall within normal limits. The mean glycemic levels of still higher order would have further spaced out values making them to fall outside the normal limit in diabetic group. Maintaining high glycemic levels intentionally in diabetic pregnant women is deleterious to mother and fetus thus undoubtedly unethical.

CONCLUSION

Diabetogenic effect of pregnancy combined by stress inducing urban lifestyle compounds the diabetiogenic effect of pregnancy to increase incidence of diabetic pregnancies. The consequence of endocrine and biochemical profile of diabetic mother on fetal erythrocyte profile is to be considered besides cardiovascular, renal and other complications.

The non-priming of neonatal interleukin-6 by immune suppressed diabetic maternal interleukin- 6 is offered as the main cause of altered counts. Since the prognosis of the child in pregnant diabetes is related to the degree of control of mother`s disease, though there are significant difference in erythrocyte profile in cord blood of neonates to non-diabetic and diabetic mother,

The above-mentioned trends in erythrocyte profile of neonates to diabetic groups tend to increase viscosity of blood, this in turn predisposes to cardiorespiratory distress, neurological symptoms and renal vein thrombosis that requires treatment apart from developmental abnormalities. It becomes point of paramount importance to manage gestational diabetes by maintaining normal glycemic levels in pregnant women so as to minimize complications which take a great toll of morbidity and mortality.

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