SERUM TOTAL LIPIDS IN PREGNANCY

by

A. V. Potnis,* Ph.D.

and

B. N. Purandare,** M.D., F.R.C.S.E., F.C.P.S., F.I.C.S., F.R.C.O.G., F.A.M.S.

Introduction

The mechanism of hyperlipemia of pregnancy has not yet been known. In 1934 Boyd listed seventeen possible etiological factors and many are being added to this list. Hormonal change during pregnancy is considered to be one of the etiological factors contributing towards the elevation of lipids. Recent experiments have supported this view and have proved that many hormones affect the level of circulatory lipids. Other theories postulated are that lipids are due to (1) absorption of fat, (2) absorption of chyle, (3) absorption of foetal metabolic products, (4) absorption of milk, (5) retardation of pulse, (6) placental toxins, (7) other toxins, (8) remote effects of the foetus, (9) decreased blood lipase, (10) suprarenal synthesis, (11) decreased lipid elimination in bile, (12) corpus luteum, (13) increased cell destruction, (14) immunological reaction, (15) increased metabolic requirements, fats, lactation, etc.

None of the concepts listed above have been experimentally demonstrated to explain the phenomenon and very few have led to constructive knowledge of fat metatabolism.

It is evident that the presence of foetus and placenta is basically responsible for the changes in lipid metabolism and the pronounced changes in hormone production during gestation have been suspected strongly as the causative factor.

Endocrine secretional changes during pregnancy are very complex. The placenta produces large amounts of several hormones which interfere with the metabolism of other hormones produced by different endocrine glands. The foetus plays an important role in the metabolism of steroids. The relationship of elevation of lipids during pregnancy and hormonal changes is yet not very clear as the knowledge about the hormones and their action is not complete.

Estrogens are formed in very large amounts during pregnancy. The main objection against accepting estrogens as a cause of hyperlipemia is that estrogen has been shown to lower plasma cholesterol, especially of the beta lipo-protein fraction. This is a contradictory finding in pregnancy. Another supporting factor to this is that after menopause, natural or surgically induced, a rise in blood lipids

---

This work is from Ph.D. Thesis of Dr. A. V. Potnis, accepted by Bombay University in February 1971.

The paper was read at Teaching Pathology meeting held on 25th March 1971 at Seth G. S. Medical College.

**Lecturer in Biochemistry, Seth G. S. Medical College.*

***Emeritus Prof. of Obst./Gynec. in Seth G. S. Medical College and Dean of Wadia Maternity Hospital.*

Received for publication on 21-5-1971.

have been demonstrated. Berezin and Studnitz in 1957, however, showed an increased in serum cholesterol levels after estrogen treatment.

Progesterone is also produced in large quantities. Its effect on lipid metabolism is still obscure. No significant changes were found in serum cholesterol and phospholipids when small doses of progesterone were administered. The chorionic gonadotrophins have no influence on elevation of lipid level in pregnancy. It is produced in large quantities in early pregnancy when lipids have just started to increase.

Hormones produced by the pituitary, adrenal and thyroid glands, have been known to have an influence on the synthesis, oxidation and mobilization of lipids as well as the plasma lipid level. Bleicher *et al* in 1964 have described a lypolytic substance.

The concept that the impaired carbohydrate metabolism may be responsible for the hyperlipemia of pregnancy has been disputed by Randle *et al* in 1963 who opines that the change in carbohydrate metabolism is secondary to the elevation of the fatty acids.

The blood lipids consist of fatty acids, both esterified and non-esterified, neutral fats, phospholipids and unsaponifiable components including cholesterol, carotenoids Vit. A, D, E, K as well as other substances in relative amounts.

Material and Methods

Majority of subjects were selected from the patients attending antenatal clinic of Dr. B. N. Purandare's Maternity Hospital and rest of the patients were selected from patients attending K.E.M. Hospital and Wadia Maternity Hospitals. Subjects were classified accordingly to their trimesterwise gestational period.

Normal non-pregnanct control group included 50 healthy cases belonging to medium socio-economic class and having normal menstrual function with no evident hormonal deficiencies.

Thirty cases in the first trimester, 31 cases in the 2nd trimester and 51 cases in the 3rd trimester of normal pregnancy were studied. These patients had systolic pressure 130 mm of Hg or less. Cases of anaemia and threatened abortion were excluded. Nausea and vomiting were observed in two thirds of cases in the first trimester.

Thirty cases of pre-eclamptic conditions were studied who had high blood pressure (systolic pressure 140 mm of Hg or more and diastolic pressure 100 mm of Hg or more). Patients had oedema on feet and on body and albuminuria was observed. Fasting blood samples were collected and the sera were separated. Analysis of the serum was carried out by the method of Kunkel *et al* for Total lipids.

Results

Table 1 represents that serum lipids are increased as pregnancy advances. In normal non-pregnant group the mean average serum lipid level was 554.9 mg%. After conception serum lipid mean average value increased to 615.9 mg in the 1st trimester. This value continued to rise as the pregnancy advanced and reached to mean average value as 811.8 mg% in the 2nd trimester. In the third trimester, it reached to the peak (955.4 mg%) value. In pre-eclampsia the mean average value was much higher, 111 mg%.

There is a rise of 11% in serum total lipid level above the normal non-pregnant group in the 1st trimester, whereas in the 2nd trimester there is a rise of 46.3% above the normal non-pregnant group and 35.3% above the 1st trimester.

TABLE I

Serum Total Lipids

Groups	Normal non-pregnant	1st Trimester	2nd Trimester	3rd Trimester	Pre-eclamptic conditions
Number of cases	50	30	31	55	30
Serum total lipids mg%	554.9	615.9	811.8	955.4	1111.0
Standard deviation (SD)	± 12.5	± 20.0	± 32.1	± 55.7	± 22.6
Standard error (SE)	± 1.77	± 3.65	± 5.76	± 7.51	± 4.12
Coefficient of variation (CV)	2.3	3.2	4.0	5.8	2.0

All differences are significant as the standard errors are very small cofpared to the differences observed $P < 0.001$.

In the 3rd trimester, there is a rise of 72.3% above the normal non-pregnant group, 61.3% above the 1st trimester and 26.0% rise above the 2nd trimester. In pre-eclampsia there is a rise of 100.2% above the normal non-pregnant group and 27.9% rise above the 3rd trimester.

This shows that there is a gradual increase of serum total lipids from 1st trimester to 3rd trimester. The mean average standard deviation is also increased from 1st trimester to 3rd trimester.

Table II represents the t-test for significance.

Discussion

Oliver and Boyd (1953) in their study of plasma lipids during menstrual cycle suggested that endogenous estrogens may be directly or indirectly responsible for their regular cyclical depression at ovulation. However, it has been subsequently shown by Eilert in 1949 and Oliver *et al* in 1955 that exogenous estrogens have a similar effect on the plasma lipids.

De Alvarez *et al* (1959) assayed serum lipids in fifteen normal non-pregnant women and compared these with 25 nor-

TABLE II

t-test for Significance (Total Lipids)

Group difference	t	df	Probability (P)
Normal non-pregnant — 1st trimester	15.024	78	<0.001
Normal non-Pregnant — 2nd trimester	42.617	79	<0.001
Normal non-pregnant — 3rd trimester	52.012	103	<0.001
Normal non-pregnant — pre-eclampsia	123.57	78	<0.001
1st trimester — 2nd trimester	28.391	59	<0.001
1st trimester — 3rd trimester	40.659	83	<0.001
1st trimester — pre-eclampsia	90.011	58	<0.001
2nd trimester — 3rd trimester	15.196	84	<0.001
2nd trimester — pre-eclampsia	42.140	59	<0.001
3rd trimester — pre-eclampsia	18.166	83	<0.001

mal pregnant women. Ten of the pregnant women were studied serially but most were admitted to the study after 12th week of pregnancy. The authors have noted a drop in serum total lipids in the period of 9-12 weeks of gestation. Present results are in contrast with these findings and a progressive rise in serum lipids is noted as the pregnancy advances. The values recorded by these authors are significant only from the period of 25 weeks onward, whereas all the differences noted in the present studies are significant ($p<0.001$). These authors have failed to explain why the serum total lipid levels drop in the first trimester.

Mullick, *et al* (1964) studied the serum lipids of women in New Delhi who were of upper medium socio-economic status. They found significantly higher total lipids, total cholesterol and beta to alpha lipo-protein ratios in the sera of the more affluent women. They have also reported the study of 60 normal pregnant women attending the antenatal clinic. These authors have observed a progressive rise in serum lipids which is a similar observation noted in the present studies even though the values are higher in the present studies as compared to the values recorded by these observers.

Gupta *et al* (1967) reported the serial study of serum lipids in 38 pregnant women of various ages between 20 and 35 years. They compared their results with only 10 normal non-pregnant subjects. A drop in serum total lipid was observed by these authors in the 1st trimester. However, no explaination was offered for this drop. Thereafter these authors have noted a progressive rise till term. Smith *et al* (1959) have recorded a very high serum total lipid level on a serial study of one patient in third trimester as 1388 mg% Vs. 955.4 mg %, the value noted in the present studies in the same trimester. As the number of patients was limited these values are questionable, as they did not have any statistical significance.

The changes in sex hormones during pregnancy must be considered in relation to the behaviour of the lipids and lipo-protein. Urinary estrogen rises steadily during pregnancy until the last month which presumably reflects the concentration of estrogens rise to the threshold level.

Venning (1946) states that it is possible that the lipids depressant action of estrogens are antagonised during pregnancy or that the concentrations or relative proportions of the various estrogens are such that the depressent action is lost.

Young (1951) states that secretion of growth hormone and the secretion of other trophic hormones are increased during pregnancy. These may be responsible for the rise in lipids during pregnancy.

In pre-eclamptic conditions, the present studies have noted a high serum total lipid level as 1111 mg % $\pm$ 22.6 mg %.

This definitely shows that toxic conditions affect the serum total lipid level. Therefore, estimation of serum total lipid level will be a diagnostic and a prognostic method in addition to the symptoms and clinical findings.

Summary

1. Estimation of serum total lipids is carried out in normal gravidas of first, second and third trimesters and in pre-eclamptic cases in the third trimester. The results are compared with normal non-pregnant control group.

2. A progressive rise in level is observed from the onset of pregnancy to term. Lipids are significantly elevated

($p<0.001$). A high level is observed in pre-eclamptic group.

Acknowledgements

The authors wish to thank the Dean, Seth G. S. Medical College & K.E.M. Hospital for the facillities and encouragement extended to them.

References

1. De Alvarez, R. R., Gaiser, D. F., Simkins, D. M. Smith, E. K. and Bratwold, G. E. Am. J. Obst. & Gynec. 77: 743, 1959.
2. Eilert, M. L.: Amer. Heart J. 38: 472, 1949.
3. Gupta, A. N., Sarkar, A. K. and Chakravarti, R. N.: Am. J. Med. Sc. 253(4): 469, 1967.
4. Mullick, S., Bagga, O. P. Du Mullick, V.: Am. J. Obst. & Gynec. 89: 766, 1964.
5. Oliver, M. F. and Boyd, G. S.: Clin. Sci. 12: 217, 1953.
6. Oliver, M. F. and Boyd, G. S.: Clin. Sci. 14: 15, 1955.
7. Smith, E. K., de Alvarez, R. R. and Forsander J.: Am. J. Obst. & Gynec. 77: 326, 1959.
8. Venning, C. A. Endocrinology. 39: 203, 1946.
9. Young, F. G. J. Clin. Endocrin. 11: 531, 1951.