

## LIPID METABOLISM IN PREGNANCY. III.

(Fatty Acid Metabolism in Normal and Abnormal Pregnancy\*)

by

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### Introduction

The pregnant female is a metabolic curiosity. The biogenesis of hyperlipidaemia and the purpose it serves during gestation are the crux of the problem. The metabolic relationship between carbohydrate and lipid in general and particularly the manifold functions of free fatty acids (FFA), also termed non-esterified fatty acids (NEFA), ever since their recognition as a part of plasma lipids, attention was directed to this fraction by various investigators, apart from the conventional cholesterol and phospholipid metabolism. Recent literature (Nelson *et al*, 1966 and Quinto *et al*, 1967) lays stress on the role of this fraction both in normal and pathological conditions including pregnancy, in conjunction with carbohydrate metabolism. Hardly anything is known about the total fatty acids (TFA),

non-esterified fatty acids (NEFA) and esterified fatty acids (EFA) contents of sera of Indian women. A study was therefore undertaken in normal and in some complications of pregnancy, like toxæmia and diabetes, to understand the etiology of these manifestations, which might be of some diagnostic or prognostic value.

### Material and Methods

Material and collection of blood samples is the same as described in part I of this series.

### Methods

Total fatty acids, esterified fatty acids and non-esterified fatty acids were determined by the methods of Pande *et al* (1963), Morgan and Kingsbury (1959) and Fredrick Mosinger (1965) respectively.

### Results

Total, non-esterified and esterified fatty acid contents in the sera of all the 3 groups of patients are represented in Tables I, II and III. Total fatty acids (Table I) and non-esterified fatty acids (Table II) were found increased both in normal pregnancy and in toxæmic patients from those of non-pregnant women in 25 cases

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TABLE I  
Total fatty acids in normal and abnormal pregnancy  
(mgm. per 100 ml. of serum)

Group	No. of cases.	Range	Mean	S.D.	't''*	't1''**
I Non-pregnant	25	156.02-362.0	262.13	± 105.18	—	—
II Normal pregnancy	25	192.0-696.0	341.68	± 97.71	2.65+	—
III Abnormal pregnancy.	25	232.0-698.0	331.68	± 101.48	2.33+	0.86

+ Significant.

\* t compared to non-pregnant group.

\*\*t1 compared to normal pregnancy group.

TABLE II  
Non-esterified fatty acids in normal and abnormal pregnancy  
(milli equivalent per litre serum)

Group	No. of cases	Range	Mean	S.D.	't''*	't1''**
I Non-pregnant	25	416.0-759.0	539.19	± 89.69	—	—
II Normal pregnancy	25	359.5-1713.6	882.76	± 372.47	4.44+	—
III. Abnormal pregnancy.	25	604.8-1669.5	806.36	± 391.45	3.26+	0.29

+ Significant.

\*t compared to non-pregnant group.

\*\*t1 compared to normal pregnancy group.

TABLE III  
Esterified fatty acids in normal and abnormal pregnancy  
(mgm. per 100 ml. of serum)

Group	No. of cases	Range	Mean	S.D.	't''*	't1''**
I Non-pregnant	25	145.98-609.4	375.74	± 150.49	—	—
II Normal pregnancy	25	166.2-753.3	466.49	± 119.46	2.19+	—
III Abnormal pregnancy.	25	141.27—	338.69	± 113.36	0.91	3.36+

+ Significant.

\*t compared to non-pregnant group.

\*\*t1 compared to normal pregnancy group.

studied in each group. These changes were found to be highly significant according to students 't' test. But, as compared to normal pregnant women, in the toxæmic pregnant women these constituents were at a slightly lower level and showed no statistical significance. The esterified fatty acids (Table III) were also significantly higher in normal preg-

nant women from those of the non-pregnant group. In the toxæmic group it was lower than that in normal pregnancy and in the non-pregnant group, with a high statistical significance between the normal pregnant and toxæmic groups.

The two diabetic patients had a high level of total fatty acids, 380.9-657.9 mgm%. NEFA values were



860.0 and 902.0 meq/Litre and the E.F.A. were in the low range of 195.1 and 142.6 mgm%. The results in the nephrotic syndrome were also similar to that of the diabetics, i.e. T.F.A. 454.0 mgm%, N.E.F.A. 869.4 meq/L and E.F.A. 185.59 mgm%.

### Discussion

The present investigations clearly show that in pregnancy there is a general rise of plasma lipid fractions, namely, total lipids, triglycerides, phospholipids (Part I); total, free and esterified, cholesterol (Part II) and total, free and esterified fatty acids (present paper). These findings are in agreement with those of previous studies (Boyd, 1934; Schwarz *et al*, 1940; Peters *et al*, 1951; Smith *et al*, 1959; De Alvarez *et al*, 1959; Burt, 1960 and Rebound, *et al* 1963).

The uniform rise in the serum lipid fractions could be interpreted in the light of the work of Quinto *et al* (1967). A combined study of glucose tolerance with NEFA and different lipid fractions in non-pregnant and pregnant women was done by these authors. Their conclusion was that in normal pregnancy lipolysis, the amount of circulating fats and peripheral utilization of fatty acids (notably the polyunsaturated ones) are increased to meet the energy requirements of tissues (Gordon and Cherkes, 1956; Laurell, 1956) and to counterbalance their reduced capacity to metabolize glucose (Kriss and Hirschom, 1948; Katsch, 1950; Burt, 1959).

In the toxæmic women both total fatty acids and non-esterified fatty acids, like other fractions, are found to be significantly increased from the

non-pregnant level, but without any marked change from those of the normal pregnant women; these are in agreement with the reports in literature (Nelson *et al*, 1966; Quinto *et al*, 1967). The most interesting observation in the present work is the significant decrease in the esterified fatty acids in the toxæmic women as compared to the other two groups. The decrease in the esterified fatty acids in these persons could not be explained especially when all other fractions were uniformly increased as seen from Tables I and II and from previous papers. However, if an exhaustive study on both the qualitative and quantitative aspects of NEFA and EFA was done, some evidence could be elucidated. Nevertheless, the present findings suggested two possibilities: (i) either the esterification, which is an obligatory step for the proper utilisation of lipids, is in some way affected; or, (ii) the hydrolysis of esterified fats, i.e., the enzymes involved in the splitting of the fatty esters, are activated in one way or other. On the whole the latter seemed to be more probable.

To sum up, in toxæmic pregnant women except for the esterified fatty acids observed in the present paper, the lipid metabolism is qualitatively similar to that observed in late normal pregnancy, but never more intense as observed by Quinto *et al* (1967). This might be due to the medication under which our patients were.

### Summary

(1) Seventy-eight cases in 3 groups, each having 25 cases of non-pregnant, normal pregnant and toxæmic

mia of pregnancy, 2 cases of diabetes and one with the nephrotic syndrome, were studied for their serum TFA, NEFA and EFA.

(2) In normal pregnancy the values were significantly higher for all fractions than those of non-pregnant ones.

(3) In toxæmia the total fatty acids and non-esterified fatty acids were significantly higher than those of non-pregnant women, but slightly lower than those of normal pregnancy. The esterified fatty acids were significantly lower than those of non-pregnant women.

(4) The two diabetic and the one nephrotic patients studied also showed similar patterns as those of the toxæmic cases.

#### Conclusion

In toxæmic, diabetic and nephrotic pregnant women studied in the present series, the changes in lipid metabolism were qualitatively similar to those observed in normal late pregnancy. The most interesting finding was the significant low level of esterified fatty acids in these pathological cases studied. This requires further elucidation.

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#### References

1. Boyd, E. M.: *J. Clin. Invest.* 13: 347, 1934.
2. Burt, R. L.: *Obst. & Gynec.* 15: 460, 1960.
3. Burt, R. L.: *Am. J. Obst. & Gynec.* 80: 965, 1960.
4. Burt, R. L.: *Obst. & Gynec.* 13: 433, 1959.
5. De Alvarez, R. R., Gaiser, D. F., Simkins, D. M., Smith, E. K. and Bratvold, G. E.: *Am. J. Obst. & Gynec.* 77: 743, 1959.
6. Fredrick Mosinger: *J. Lipid Res.* 6: 157, 1966.
7. Gordon, R. S., Jr. and Cherkes, A.: *J. Clin. Invest.* 35: 206, 1956.
8. Katsch, G.: *Zlil. Gynec.* 72: 1756, 1950.
9. Kriss, J. P. and Hirschom, W.: *Wien. Klin. Wschr.* 46: 616, 1948.
10. Laurell, S.: *Scand. J. Clin. Lab. Invest.* 8: 81, 1956.
11. Morgan, D. M. and Kingsbury, K. J.: *Analyst.* 84: 109, 1959.
12. Nelson, G. H., Frederick, P., Zuspan and Lewist, T. Mulligan: *Am. J. Obst. & Gynec.* 94: 310, 1966.
13. Pande, S. V., R. Parin Khan and Vankit Subramanian, T. A.: *Analyt. Biochemistry.* 6: 415, 1963.
14. Peters, J. P., Martin Heinemann and Evelyn B. Man: *J. Clin. Invest.* 30: 388, 1951.
15. Quinto, P., Bottiglioni, F. and Flamigni, C.: *J. Obst. & Gynec. Brit. Comm.* 74: 544, 1967.
16. Reboud, P., Groulade, P., Paule Gros Lambert, M. Colomb: *Am. J. Obst. & Gynec.* 86: 820, 1963.
17. Schwarz, O. H., Soula, S. D. and Beonice Dunie, A. B.: *Am. J. Obst. & Gynec.* 39: 203, 1940.
18. Smith, E. K., de Alvarez, R. R. and Forsander, J.: *Am. J. Obst. & Gynec.* 77: 326, 1959.