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BRIEF NOTES AND COMMENTS

A Plea for Plasma Sugar

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In the practice of medicine it is customary to estimate the extracellular sugar concentration by analysis of whole blood rather than serum or plasma. Over the years, various methods to prepare filtrates have been developed, with the barium-zinc precipitation of Somogyi the most commonly accepted. Analysis of filtrates by the Nelson method gives concentration approaching those of glucose present. Now the AutoAnalyzer is coming into general use, and its dialysate yields sugar values by the Hoffman ferricyanide method nearly identical with those determined according to Somogyi and Nelson. Certain aspects of the interpretation and automated determination of whole blood concentrations have led us to believe, however, that serum or plasma should be analyzed instead.

First, in evaluating carbohydrate metabolism it is desirable to know the extracellular concentration of glucose, for it is the content of this space which changes with absorption, production, and utilization of glucose. The plasma concentration approaches that of the extracellular space, while whole blood values fall short. Whole blood glucose includes that of the red cells, which, because of their low water content, have a glucose concentration considerably below that of plasma. In table 1 are shown values obtained from samples of blood drawn from 105 normal and diabetic subjects. The samples were preserved in a fluoride-oxalate mixture, and plasma and blood subjected to sugar analysis on the Auto-Analyzer. The red cell sugar was calculated from the plasma and blood concentrations and hematocrit. Note that the plasma values are on the average 14 per cent higher than those of whole blood, a percentage increase which is not influenced by changes in the glucose levels. Similar findings have been reported by McDonald et al.[1]

Second, whole blood values will lie somewhere between those of the red cells and plasma in accordance with the hematocrit. The same plasma value may be expressed differently in whole blood of different persons depending on the presence of anemia or polycythemia. To examine the influence of hematocrit, the above data were arranged in multiple-regression form with the blood sugar as the dependent variable:

$$\hat{Y} = 13.2 + 0.88X_1 - 0.36X_2$$

where $\hat{Y}$ = Estimated blood sugar (mg. per 100 ml.)
X_1 = Plasma sugar (mg. per 100 ml.)
X_2 = Hematocrit (per cent).

TABLE 1

The values of blood, plasma, and red cell sugars and hematocrits determined simultaneously on 105 samples of blood

		Mean ± Standard Deviation
Blood sugar	(mg. per 100 ml.)	123.5 ± 63.1
Plasma sugar	(mg. per 100 ml.)	140.4 ± 71.5
Red cell sugar	(mg. per 100 ml.)	93.0 ± 48.9
Hematocrit	(per cent)	35.8 ± 5.1

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Both regression coefficients are highly significant: the F value for the effect of plasma sugar is 122, and that of the hematocrit is 19.5. It can be stated from the equation that, at any given plasma sugar concentration, a change in hematocrit of 10 units will cause a change in opposite direction of blood sugar of 3.6 mg. per 100 ml. In other words, the more anemic the subject, the higher the whole blood sugar becomes. In the present day search for more sensitive interpretation of extracellular sugar concentrations, the use of plasma would eliminate this source of systemic error.

Third, it is very likely that automation will eventually replace manual methods in all laboratories with large volumes of work. The use of plasma instead of whole blood in the AutoAnalyzer is preferable. Improper collection and coagulation of blood specimens leads to small clots which frequently clog the tubing of the sample line or the manifold glass fitting. In contrast, obstruction from plasma is rare. An additional benefit from the use of plasma is that other simple determinations can be done simultaneously, a feature in keeping with modern laboratory logistics.

There is at present a worthy argument against the use of plasma. With the use of the "true" glucose methods, and with the experience of many years of standardizing glucose tolerance in various conditions, interpretation of values has become much more meaningful. But the values are those of whole blood. To move to the use of plasma would require re-education for proper understanding of concentrations that border on the abnormal, just at a time when we are arriving at a better understanding of whole blood concentrations.

In spite of the last argument, we believe that efforts should be made to convert to plasma for sugar determination. Only minimal re-education will be required in interpretation of single values, used, for example, in controlling diabetes or searching for hypoglycemia. But it will be more difficult in evaluation of tolerance tests. Nevertheless, the shift has been made successfully from measuring heterogeneous-reducing substances to mainly glucose, and conversion can be made to serum or plasma. Indeed, many hospitals are now analyzing plasma without the clinicians being aware of the change. Finally, tolerance tests which are now intermediate in nature and difficult to judge normal or abnormal may ultimately lose importance because of future development of other means of diagnosing diabetes.

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BOOK REVIEW

A TEXTBOOK OF MEDICINE. *Russell L. Cecil and Robert F. Loeb. Edited by Paul Beeson, M.D., and Walsh McDermott, M.D. $19.00, 1835 pages, 11th Edition, W. B. Saunders, Philadelphia, 1964.*

With the retirement of Drs. Russell Cecil and Robert Loeb, the editorship of the eleventh edition of the *Textbook of Medicine* has passed into the capable hands of Dr. Paul Beeson and Dr. Walsh McDermott. Needless to say they have retained the basic format responsible for the universal acceptance of previous editions. The broad topics continue to be subdivided into neat packets, individually easily read, and digested. Each subsection is written by an acknowledged authority in his field. The bibliographies are short but contain historically many important papers of broad scope. The number of contributors has been substantially increased to a total of 160.

The notable changes are as follows: The section of hematology has been updated under the guidance of Carl V. Moore. He has personally written introductions to almost all of the subsections in the division which adds an appropriate thread of continuity to this topic. The field is systematically and logically covered in about 100 pages. The diseases of the digestive system are presented from a physio-pathologic point of view, thus departing from the strictly anatomic approach previously adhered to. This is a minor but appropriate change.

A discussion of genetic principles introduces the section on inborn errors of metabolism. It is presented clearly and concisely by Alexander Bearn who together with Alexander Gutman and associates proceed to touch briefly upon individual clinical entities.

The section devoted to diabetes which had been written by Robert Loeb in the past has been minimally revised by Phillip K. Bondy. The discussion is basic and sound, avoiding extreme points of view. The method for handling diabetic acidosis is especially clear and succinct. The author is unduly pessimistic concerning the use of oral hypoglycemic agents other than tolbutamide and newer approaches in the management of diabetic retinopathy.

The remainder of the book is essentially unchanged. The type size and spacing as well as the standard double column layout are pleasing to the eye. Figures and illustrations have been held to a minimum and are therefore helpful without spoiling reading continuity. It suffers only the basic deficiency that do all books of its type. Namely, in an effort to walk the narrow line between a reference book and a textbook it becomes too much a depersonalized compendium for the student to feel comfortable with and not detailed enough for the reference seeker. Granting this intrinsic qualification, we are certain that the *Textbook of Medicine* will continue to occupy a well deserved place on the bookshelf of the physician and medical student alike.