# Comment

## AN EVALUATION OF PERFUSION TECHNIQUES IN THE STUDY OF WATER AND ELECTROLYTE ABSORPTION IN MAN: THE PROBLEM OF ENDOGENOUS SECRETIONS

Sladen and Dawson (*Gut*, **9**, 530-535) state that fasting intestinal contents cause negligible errors in calculated water absorption rates during intestinal perfusion studies. This conclusion is based on the finding of, generally, higher water absorption rates from glucose-saline solutions with a 2-lumen perfusion tube than with a 3-lumen tube, the latter allowing for mixing of test solution with the fasting intestinal contents before entry into the test segment. The design of the experiments which the authors undertook, to compare the performance of the two types of tube, introduced, however, additional variables (different flow rates and composition of solution in the test segment; studies performed on different days and, apparently, on different subjects), rendering their results uninterpretable as to the presence or magnitude of the effect of fasting intestinal contents on the calculated water absorption rate. We have observed up to 50% of the infused solution (20 ml per min) to reflux to a point 15 cm proximal to the infusion tip, resulting in an effectively perfused gut segment of unknown length when a 2-lumen tube is used. In addition, the authors elected not to reduce the variability of calculated absorption rates by accounting for the transit time of the solution through the test segment (Whalen, Harris, Geenen, and Soergel, 1966). Lastly, absorption rates should be presented in relation to the geometric mean solute concentration in the test segment, rather than to the composition of the fluid upon entry into this segment.

In commenting on our estimates of fasting intestinal contents flow rates the authors quote Jacobson, Bondy, Broitman, and Fordtran (1963), as having shown that PEG 4000 adheres to the mucosal surface. On the contrary, Jacobson *et al* concluded that some water containing inert marker is trapped between the intestinal folds, making volume estimates based on marker concentration changes more accurate than the volume actually recovered from closed intestinal loops.

In view of the accumulated evidence published by others and of the inconclusive experiments of Sladen and Dawson, the use of the 2-lumen tube for the study of water and electrolyte absorption rates can, in our opinion, not be recommended.

### REFERENCES

Jacobson, E. D., Bondy, D. C., Broitman, S. A., and Fordtran, J. S. (1963). Validity of polyethylene glycol in estimating water volume. *Gastroenterology*, **44**, 761-767.

Whalen, G. E., Harris, J. A., Geenen, J. E., and Soergel, K. H. (1966). Sodium and water absorption from the human small intestine. *Ibid.*, **51**, 975-984.

KONRAD H. SOERGEL
*Milwaukee County General Hospital, Milwaukee, Wisconsin, USA*

G. E. SLADEN AND A. M. DAWSON *reply*

We undertook specifically to compare water and sodium absorption rates in two different groups of normal individuals using the two methods. The aim was to find out if there was any statistically significant systematic underestimation of mean absorption rates by the 2-lumen tube. We admit that, in the glucose-saline perfusions, it was impossible to assure exactly comparable flow rate and composition of solutions entering the test segments, but we obtained approximately comparable conditions by using different flow rates and glucose concentrations. In the isotonic saline perfusions, however, flow rates and luminal sodium concentrations were virtually identical in the two groups of observations. We were unable to demonstrate that the 2-lumen tube underestimated mean absorption rates in this type of study. We would like to stress again that our interpretation of these findings does not apply to individual studies, pathological states, or to other solutes. Our major reason for attempting this comparison was the fact that we were not satisfied with the 3-lumen tube, because absorption by the mixing segment prevented us from studying the effects of small, known concentrations of glucose on sodium and water absorption. As one of us has pointed out in a recent editorial (Sladen, 1968) the ideal way of circumventing this problem is probably the use of a 2-lumen tube with proximal occlusive balloon. We are currently using this method and comparing absorption periods in individuals with the balloon inflated and deflated.

In reply to the other points raised by Dr Soergel:

1 The fact that massive reflux can occur would not be denied. Statistically, this would be important if reflux occurred continuously for the whole of the equilibration and collection periods (for at least an hour) in the majority of individuals tested. This seems unlikely and has not, to our knowledge, been demonstrated.

2 We did, in fact, use the 'staggering' method of calculating absorption rates, recommended by Whalen, Harris, Geenan, and Soergel (1966), but only in the minority of cases where there was more than 10% variation in marker and solute concentrations in triplicate proximal and distal collections. The more ideal the steady state, the less difference would 'staggering' make to the results.

3 We agree that segmental absorption rates of solute should be related to the geometric mean luminal solute concentration, but only in situations where the concentration alters very considerably along the segment, for example, in the case of glucose or aminoacids. Even then the geometric mean is only a rough approximation to an integral function of concentration with respect to distance down the segment. There is no evidence that water absorption is related to geometric mean rather than to initial glucose concentration and the sodium concentrations in the test segments did not alter greatly. Furthermore, for comparative purposes it would seem reasonable to use initial concentrations.

4 We did not state that Jacobson, Bondy, Broitman, and Fordtran (1963) had shown that PEG 4000 adheres to the mucosal surface. We said that they 'have shown

that correlation between measured and calculated volumes is much better in a fairly fast perfusion system than in a closed loop'. They found that approximately 100% PEG recovery could be obtained from closed loops only on 'repeated washing'. A perfusion system may provide such a washing effect. In their discussion they actually state that 'absorption of PEG on to mucosal cells, however, is not conclusively excluded by these results'. We still feel that the extremely slow perfusion system, described by Whalen *et al* (1966), is open to the criticism that the very long transit times might allow considerable inequalities of marker distribution across the lumen to develop.

5 There is, in fact, little published evidence on the magnitude and practical significance of contamination of this sort. The most elaborate relevant studies are those of Whalen *et al* (1966), but we consider that their methods are open to the criticisms detailed in the preceding paragraph and in the discussion section of our paper.

Finally, we wonder what other explanation there can be for our finding that contamination does not underestimate absorption rates in the type of study, which we described.

G. E. SLADEN
A. M. DAWSON
*St Bartholomew's Hospital, London, EC1*

REFERENCES

Jacobson, E. D., Bondy, D. C., Broitman, S. A., and Fordtran, J. S. (1963). Validity of polyethylene glycol in estimating intestinal water volume. *Gastroenterology*, **44**, 761-767.
Sladen, G. E. (1968). Perfusion studies in relation to intestinal absorption. *Gut*, **9**, 624-628.
Whalen, G. E., Harris, J. A., Geenan, J. E., and Soergel, K. H. (1966). Sodium and water absorption from the human small intestine. *Gastroenterology*, **51**, 975-984.

# Notes and activities

BOOKS OF INTEREST TO READERS OF *Gut*

*Natural Antinutritive Substances in Foodstuffs and Forages* By Iancu Gontzea and Paraschiva Sutzescu. The purpose of this book is to describe naturally occurring constituents of some foods which on ingestion adversely attack the state of nutrition. Additive toxins due to cultivation or manufacture are excluded, and the book is concerned only with naturally occurring antinutrients. These are divided into three main groups according to whether they depress the digestion or metabolic utilization of protein, reduce the availability of minerals, or inactivate or increase the requirements for certain vitamins. The protein inhibitors include antiproteases present in various foods, including legume seeds. Another section deals with oxalic acid which is present in spinach and rhubarb. The Brassica family, including cabbage, contains substances which increase the levels of thiocyanate in the blood and depress absorption of iodine by the thyroid gland. The antiproteases, and also certain vitamin inhibitors, are of special interest in gastroenterology and may contribute to symptoms. It is a monograph primarily written for nutritional scientists, but is also a publication which should be known to all those actively engaged in academic gastroenterology. It is very well documented, and prefaced by Sir David Cuthbertson. (Published by S. Karger, Basel, Switzerland and New York.)

*Abdominal Operations* Published in two volumes this is practically a new book compared with the fourth edition of 1961. It deals with choice of operation, difficulties and dangers which may arise during operation, and pre-and postoperative care in great detail, with special reference to complications. It is written by an Anglo-American team of 82 with British surgeons, physicians, and pathologists very well represented. Younger men wherever appropriate have been invited to contribute. The net result is a most up-to-date and quite invaluable record of modern knowledge and practice. The book should be available in all gastroenterological departmental libraries and hospital medical libraries. (Published by Appleton-Century-Crofts.) Price £20 set of two volumes.

*Diagnostic Uses of Radioisotopes in Medicine* This volume of 104 pages brings together present-day diagnostic radioisotope techniques available to the clinician. It covers the main fields of medicine; the section on gastroenterology is written by D. N. Croft. A real asset for all engaged in hospital medicine. Price 15*s*.

THE SECOND INTERNATIONAL SYMPOSIUM ON GASTROINTESTINAL MOTILITY This will be held at Villa Falconieri, Frascati, Rome, from 10 to 14 September 1969. All information can be had from Dr Torsoli, 11 Clinica Medica dell'Universita, Viale del Policlinico, 00100 Rome.