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# Occurrence of Blood Group Specific Substances in Gastric Juice of Patients with Pernicious Anemia.

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The term "blood group" designates a certain property of the blood. It has been shown that the fixed tissue cells of the entire body exhibit the same group-specific characteristics as the blood cells;[1, 2, 3] and consequently, the label "blood group" does not do justice to the far-reaching group specific differentiation in man. The concentration of group-specific substances in various organs differs considerably. The brain contains very little, if any; the pancreas and intestinal mucosa, on the other hand, are rich in them—more so than the blood cells. Saliva and gastric juice are characterized by a high content of the substances which are secreted continuously as the result of an independent metabolic process.

Roughly 80% of all human beings secrete group-specific substances in both saliva and gastric juice; 20% fail to do so.[4, 5, 6] Secretion and non-secretion are constant and inherited properties and the gene of secretion is dominant over that of non-secretion.[7] The question arises as to whether the capacity to secrete blood-group specific substances is influenced in certain pathological conditions of the gastric mucosa.

Twelve patients with Addisonian pernicious anemia were examined for their capacity to secrete group-specific substances into the gastric juice and saliva. Table I shows the results of the examination of the gastric juice in regard to free and total hydrochloric acid, pepsin content, and pH, as well as the blood group.

Seven of the patients belonged to blood group O, 4 to group A, and one to group AB. The results of the chemical examination of the gastric juices are typical for pernicious anemia.

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5 Lehrs, H., *Z. f. Immunitätsf.*, 1930, **66**, 175.

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TABLE I.
Pernicious Anemia Cases.

| Patient | Blood group | Free HCl | Total HCl cc 0.1 N/100 cc | Pepsin | pH |
|---|---|---|---|---|---|
| 1 | O | X | X | X | 8.65 |
| 2 | O | X | X | X | 7.00 |
| 3 | A | X | X | X | 5.30 |
| 4 | O | none | 7 | none | 6.35 |
| 5 | A | " | 4 | " | 6.89 |
| 6 | A | " | 5 | " | 6.99 |
| 7 | A | " | 2 | " | 6.78 |
| 8 | O | " | 5 | " | 6.85 |
| 9 | O | " | 6 | present | 6.93 |
| 10 | O | " | 7 | none | 5.88 |
| 11 | O | " | 8 | " | 6.98 |
| 12 | AB | " | 3 | " | 7.91 |

X—Missing.

The quantitative determination of the group-specific substances in gastric juice and saliva was carried out by means of the so-called inhibition of agglutination test. Table II illustrates an experiment to determine the content of A-specific substance in the gastric juice and saliva of two patients belonging to group A.

Decreasing amounts of saliva and gastric juice respectively (volume 0.2 cc) were kept for 15 minutes at room temperature, together with 0.1 cc inactivated 1:3 diluted human serum belonging to group B. 0.2 cc of a 1% suspension of human red blood cells, group A, were then added to each tube. Agglutination was recorded following centrifugation of the tubes.

TABLE II.
Agglutination of Human Cells Belonging to Group A by Serum of Group B After Treatment of the Latter with Increasing Dilutions of Saliva and Gastric Juice Respectively.

| | | Controls | | Pernicious anemia | | Pernicious anemia | |
|---|---|---|---|---|---|---|---|
| | | a | b | c | d | e | f |
| Dilutions of gastric juice and saliva | | Normal gastric juice Secretor (65) Group A | Normal Saliva (Wol.) Non-secretor Group A | Gastric juice Patient Bram. Group A | Saliva | Gastric juice Patient Schin. Group A | Saliva |
| 1 | Undiluted 0.2 | — | ++++ | — | — | — | — |
| 2 | 1:3 | — | ++++ | — | — | — | — |
| 3 | 1:9 | — | ++++ | — | — | — | — |
| 4 | 1:27 | — | ++++ | — | — | — | — |
| 5 | 1:81 | — | ++++ | — | — | — | — |
| 6 | 1:240 | — | ++++ | — | — | — | — |
| 7 | 1:720 | — | ++++ | — | ± | — | + |
| 8 | 1:2200 | ± | ++++ | — | + | — | + |
| 9 | 1:6600 | + | ++++ | — | +++ | ± | + |
| 10 | 0 | ++++ | ++++ | ++++ | ++++ | ++++ | ++++ |

— No agglutination.
± Faint agglutination.
+ Slight agglutination.
++ Marked agglutination.
+++ Strong agglutination.
++++ Very strong agglutination.

It may be seen from Table II that gastric juice and saliva from 2 patients suffering from pernicious anemia contain the A substance. The amount secreted in the gastric juice seems to be at least as large as that of normal gastric juice. The examination of the 4 cases belonging to group A, as well as of the AB case, gave essentially identical results in regard to the secretion of A specific substance. All 5 cases were secretors. The AB case secreted both the A and the B substance into the gastric juice as proved by the inhibition of agglutination test. No case belonging to group B was among the group of the 12 pernicious anemia cases which we had the opportunity to examine.

Inasmuch as 7 of the 12 cases of pernicious anemia belonged to group O, it seemed desirable to determine whether the O substance was secreted in the gastric juice. The demonstration of the O substance is possible by means of certain beef sera. The technic used in the preparation of anti-O beef sera has been referred to in a previous communication.[8] Briefly, certain selected beef sera, after being absorbed with red blood cells belonging to group $A_1B$ agglutinate red blood cells of group O and of group $A_2$, while they agglutinate $A_1$ cells and B cells only slightly.

A typical experiment carried out in order to show the presence or absence of the O specific substance in the saliva and gastric juice of 2 patients belonging to group O is recorded in Table III. Decreasing amounts of gastric juice (volume 0.2 cc) were mixed with 0.1 cc of 1 :4 diluted anti-O beef serum No. 11. The tubes were kept at room temperature for 15 minutes and then 0.1 cc of 1% suspension of

TABLE III.

Agglutination of Human Cells of Group O by Anti-O Beef Serum After Treatment of the Latter with Increasing Dilutions of Saliva and Gastric Juice Respectively.

| | Dilutions of gastric juice and saliva | Control a Normal gastric juice Non-secretor Group O | Pernicious anemia b Gastric juice Patient Dun. Group O | Pernicious anemia c Saliva Patient Dun. Group O | Pernicious anemia d Gastric juice Patient Durk. Group O | Pernicious anemia e Saliva Patient Durk. Group O |
|---|---|---|---|---|---|---|
| 1 | Undiluted 0.2 cc | ++ | + | +++ | — | — |
| 2 | 1:3 " " | ++ | + | +++ | — | — |
| 3 | 1:9 " " | +++ | ++ | +++ | — | — |
| 4 | 1:27 " " | +++ | ++ | +++ | — | ± |
| 5 | 1:81 " " | +++ | +++ | +++ | ± | + |
| 6 | 1:240 " " | +++ | +++ | +++ | + | + |
| 7 | 1:720 " " | +++ | +++ | +++ | + | + |
| 8 | 1:2200 " " | +++ | +++ | +++ | ++ | + |
| 9 | 0 " " | +++ | +++ | +++ | +++ | +++ |

[8] Witebsky, E., and Klendshoj, N. C., *J. Exp. Med.*, 1941, **73**, 655.

human blood cells belonging to group O were added. The tubes were kept again for 15 minutes at room temperature and centrifuged.

Table III shows that the agglutination of human group O cells by anti-O beef sera is inhibited by the gastric juice and saliva of patient Durk., proving the presence of O substance in both. Patient Dun. apparently did not secrete the O substance in the gastric juice, since the agglutination of O cells is inhibited only slightly by the gastric juice of this patient. The examination of his saliva, also, showed a complete absence of O specific substance, indicating that this patient belongs to the group of non-secretors.

*Conclusion.* The gastric juice of patients suffering from pernicious anemia contained blood group specific substances at least in the same large amounts as normal gastric juice in spite of the fact that there was no free hydrochloric acid or pepsin present in the specimens. Eleven of the 12 patients were proved to belong to the so-called secretor group, while one was a non-secretor.

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## I. Nature of Urobilin Obtained after Amalgam Reduction of Human Fistula Bile.*

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The reduction of crystalline bilirubin either by amalgam or catalytic methods is known to yield the well-defined chromogen, mesobilirubinogen.[1-4] The *in vitro* oxidation of mesobilirubinogen leads to urobilin IX,a,† not to stercobilin.[5, 6, 7] The latter substance as

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2 Fischer, H., and Meyer-Betz, F., *Z. physiol. Chem.*, 1911, **75**, 232.

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4 Fischer, H., and Adler, E., *Z. physiol. Chem.*, 1931, **200**, 209.

† This substance was first described under the name of K-urobilin.[6] The designation IX,a simply indicates a configuration corresponding with mesoporphyrin IX, the porphyrin ring being opened at the a-methene bridge.

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