POLSKI TYGODNIK LEKARSKI, Vol. XVII, No. 14/1962

W. OLSZEWSKI

THE BLOOD AMMONIA LEVEL IN THE DIAGNOSIS OF THE SOURCE OF HEMORRHAGE FROM THE UPPER GASTROINTESTINAL TRACT

I Department of Surgery, Medical Academy, Warsaw

Proper treatment of acute, massive hemorrhage from the upper gastrointestinal tract depends on a correct ascertainment of the source of bleeding. Many a time the alimentary canal X-ray examination can hardly be indicated owing to the patients condition, besides such an examination is not always reliable. Nor do the esophago- or gastroscopy or the so called hepatic tests usually give an answer.

To distinguish between a hemorrhage from a gastric or duodenal ulcer and that from esophageal varices is most essential for a surgeon. According to some authors (4, 5, 8), estimation of the peripheral blood ammonia level may be useful in such cases. Ammonia in human organisms occurs first of all in the intestines, due to bacterial decomposition of protein. Carried away from there by portal circulation, ammonia is sent into the liver, which seizes it almost completely and transforms it into urea through ornithine-citrullin-arginine (3, 4, 7). In patients with cirrhosis of the liver, seizure and transformation of ammonia is limited and due to created collateral circulation. Rich in NH_3 portal blood, probably enters the systemic circulation, passing the liver by. Decomposition of blood protein, stored in the intestine during the hemorrhage from the esophageal varices, takes place. Then the excessive ammonia, passing by the cirrhotic liver, enters the blood where its increased level may be estimated by chemical tests. Due to regular portal circulation and functionally efficient liver, the blood ammonia level remains normal in non-cirrhotic patients suffering from massive hemorrhage form the upper gastrointestinal tract. Taking the above into account, some authors (1, 2, 5, 8) consider an increased peripheral blood ammonia level as a diagnostic indication in hemorrhage from esophageal varices. Having in view the possible wide practical application of that method, we decided to check it using our own available cases.

METHODS AND OBSERVATIONS

For quatitative estimation of blood ammonia the J. M. Jouany and M. Reynier method was used, which was described in Polish literature by *Zawadowski* (11). Elbow vein blood was examined not later than 2—10 minutes after its collection.

Preliminary control examinations were carried out to estimate average regular blood NH_3 level. A 20 patient control group was selected. By clinical examination cirrhosis of liver was excluded in all cases concerned. Normal diet was prescribed for 10 patients, the other 10 were on diet for 3 consecutive days, i. e. for the period of our test. The established standard was compared with result obtained from bleeding patients.

In a 40 patient control group with massive hemorrhage from the upper gastro-intestinal tract a single estimation of the NH_3 level was made within 6—20 hrs after bleeding had been observed. In all cases test blood was collected before transfusion took place. Final diagnosis was stated either by X-ray examination or during the performance of an operation.

RESULTS

In normal patients the average blood ammonia level varies considerably according to the estimation method (1, 2, 3, 4, 5, 6, 8). In our test where the Jouany-Reynier method was applied they were as follows: I. normal diet control group — 24—92 $\gamma\%$, average — 47·7 $\gamma\%$, II. non-protein diet groups — 16—76 $\gamma\%$, average 40·2 $\gamma\%$ (Table I).

Out of 40 patients with massive hemorrhage from the upper gastro-intestinal tract, the cause in 10 of them was burst esophageal varix, in 28 the hemorrhage was from a gastric or duodenal ulcer, in one cancer of the stomach and in 1-hemorrhagic gastritis *(gastritis haemorrhagica)*.

In patients bleeding from esophageal varices, the ammonia level varied from 44 to 122 $\gamma\%$, average 94·0 $\gamma\%$ (Table I).

In the remaining group of patients bleeding from a gastric or duodenal ulcer, the NH level ranged from 16—106 $\gamma\%$, average 51 $\gamma\%$ (Fig. 1).

In spite of distinct symptoms of hepatic coma in the one patient bleeding from esophageal varices the NH_3 level was normal.

M. P., 48 years old. For 3 days repeated massive coffee grounds-like vomiting. Liver considerably enlarged.

X-ray of alimentary canal: large esophageal varices. The patient did not agree to a proposition of binding up his esophageal varices. Symptoms of hepatic coma increased gradually on the next day. Ammonia level during 2 consecutive days: 44 $\gamma\%$, 42 $\gamma\%$ respectively. The patient died on the second day of his hospitalization.

Post mortem: cirrhosis of the liver, esophageal varices. The low ammonia level could not be explained.

In most patients with hemorrhage from a gastric or duodenal ulcer and in those bleeding from cancer of the stomach or *gastritis haemorrhagica*, the NH_3 level remained within the limits considered normal. Only in 3 patients was the ammonia level very high. These cases should be discussed seperately.

P. J., 38 years old. Massive sedimental vomiting twelve hours previously. X-ray of alimentary tract: ulcerous niche in the stomach NH_3 level within 3 consecutive days: 106 γ%, 102 γ%, 108 γ% An operation revealed gastric ulcer and cirrhosis of liver. Gastrectomy according to Rydygier.

F. R., 61 years old. Tarry stool 24 hours previously. X-ray of alimentary canal: ulcerous niche in the stomach NH_3 level — 106 γ%. Duodenal ulcer found during an operation performed after two days. Liver normal. Gastrectomy according to Rydygier.

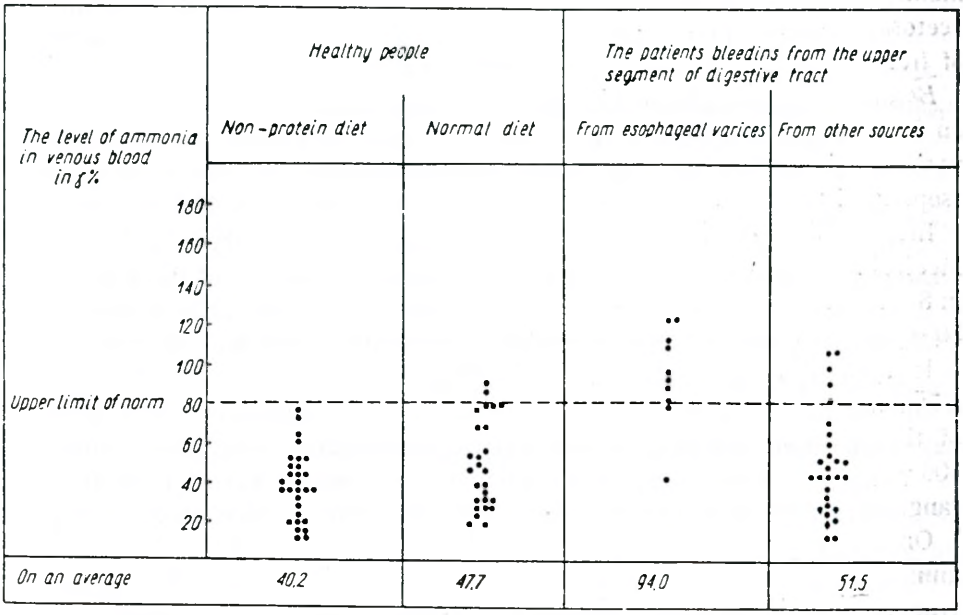

Fig. 1

R. K., 41 years old. Tarry stool twenty hours previously. X-ray of alimentary canal: ulcerous niche in the stomach. Ammonia level for 3 consecutive days: 100 γ%, 106 γ%, 30 γ% Postulcerous scar in duodenum found during an operation performed after 4 days. Gastrectomy according to Rydygier.

In spite of bleeding from a gastric ulcer and not from esophageal varices, cirrhosis of liver might have been the reason for the increased ammonia level in the first patient. The increased ammonia level in the remaining two cases could not be explained.

DISCUSSION

In recent years it has been mainly *McDermott*, *Stahl* and *Bockel* as well as *Belkin* and *Conn* (1, 5, 8, 9, 10) who have inquired into differentiation of bleeding from the upper gastrointestinal tract on the basis of peripheral blood ammonia

level. In general they agree that in patients with esophageal varices, the peripheral blood NH_3 level is higher than the average during the bleeding. According to: 1) *Stahl* it is over 80 γ%, average 116 γ%, 2) *Belkin* and *Conn* — over 150 γ%, 3) *McDermott* — over 139 γ%.

However, patients with bleeding from esophageal varices whose NH_3 level was normal, as well as patients bleeding from gastric or duodenal ulcer with high blood ammonia level, were also seen by those authors. Such incompatibilities are explained by those authors by an unexpected increase of blood ammonia level in shock, in circular insufficiency, after muscular strain or due to acetosalamid and by a decrease of the ammonia level in patients with cirrhosis of liver due to treatment with antibiotics or glutamic acid.

Bordin's (2) opinion in his work is slightly different. He does not think that an increased blood NH_3 level is characteristic in hemorrhage from esophageal varices. His opinion is based on observations of 12 patients bleeding from esophageal varices, where normal values of ammonia were observed in 7 cases.

Investigations carried out in the First Department of Surgery of the Warsaw Medical Academy show that out of 10 patients bleeding from esophageal varices, in 8 cases the NH_3 level was higher than normal (normal upper limit accepted — 80 γ%) and ranged from 44—122 γ%, average 94 γ%.

In spite of hepatic coma symptoms in one patient, ammonia values were normal. In patients bleeding from a gastric or duodenal ulcer, from cancer of the stomach or from hemorrhagic gastritis, NH_3 values varied from 16—106 γ%, average 51·5 γ%. In two cases with no cirrhosis they unexpectedly ranged over 100 γ%.

On the basis of literature and our own experience the estimation of the blood ammonia level in patients with massive hemorrhage from upper gastrointestinal tract seems to be one of the laboratory methods that could be applied in differentiation of the source of bleeding. It is essential when very high NH_3 values in peripheral blood have been found. Low values fail to exclude either cirrhosis of liver or portial circulation disturbances. Our investigations show that, in general, the blood ammonia level is higher in patients with hemorrhage from esophageal varices, but that cannot be considered an absolute proof of cirrhosis of liver. That is disproved by our findings: low NH_3 values in a patient with undoubted cirrhosis of liver and high ammonia level in patients with normal liver. As the following conclusions are based on relatively few observations, they should be confirmed by testing a larger control group.

CONCLUSIONS

1. Blood ammonia level standard in normal patients estimated by Jouany-Reynier method was: a) on normal diet 47·7 γ%, b) on non-protein diet — 40·2 γ%. Average standard upper limit — 80 γ%.

2. Average blood ammonia level in 10 patients with cirrhosis of the liver of hemorrhage from esophageal varices was 94 γ%.

3. Average blood NH_3 level in patients with hemorrhage from a gastric or duodenal ulcer or due to cancer of the stomach or hemorrhagic gastritis was 51·5 γ%. That level was within limits considered normal.

4. According to the results of our investigations, in general blood NH_3 leve, in patients with hemorrhage from esophageal varices is increased; howeverl it cannot be taken as an absolute proof either of cirrhosis of liver or portal circulation disturbances.

Translated by R. Linke

REFERENCES

1. *Belkin, G.* and *Conn, H.*: Blood ammonia concentration and bromsulfalein retention in upper gastrointestinal hemorrhage. New Engl. Med. J., 1959, 260, 530.
2. *Bordin, E.*: Blood ammonia determination as a diagnostic tool in the differentiation of upper gastrointestinal bleeding. Gastroenter., 1959, 37, 457.
3. *Calkins, G.*: The blood ammonia in normal persons. J. Clin. Lab. Med., 1956, 47, 343.
4. *Conn, H.*: Ammonia tolerance in liver disease. J. Lab. Clin. Med., 1960, 55, 855.
5. *McDermott, W. jr.*: A simple discriminatory test for upper gastrointestinal hemorrhage. New Eng. J. Med. 1957, 257, 1161.
6. *McDermott W. jr Adams R.* and *Riddell A.*: Ammonia levels in blood and cerebrospinal fluid. Proc. Soc. Exp. Biol. Med. 955 88 380.
7. *McDermott, W. jr*: Metabolism and toxicity of ammonia. New Engl. J. Med. 1957, 257 1076.
8. *Stahl, J.* and *Bockel, R.*: L'ammoniemie dans le diagnostic des hemorragies digestives. Strasbourg Med. 1956, 7, 389.
9. *Stahl J.* and *Bockel, R.*: L'ammoniemie posthemorhagique— sa valeur dans le diagnostic des hemorragies digestives. Rev. Franc. Clin. Biol., 1958, 3, 393.
10. *Stahl J.*: L'ammoniemie dans la cirrhose et ses complications. Rev. Med. Chir. Mal. Foie, 1960, 35 169.
11. *Zawadowski, J., Szczygieł B.* and *Kaleta, Z.*: The ammonia level in the blood after the ligation of hepatic artery in dogs. (Poziom amoniaku we krwi psów po podwiązaniu tętnicy wątrobowej). Pol. Tyg. Lek., 1960, 15, 1220.