The Relationship Between Vagotomy and Urine Acid Output

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Summary: *In this study we applied the test to 24 patients who had undergone duodenal ulcer operation, to 10 normal volunteers who had taken 300mgm/day ranitidin for 2 days and to 10 patients who had inguinal hernia and who hadn't any duodenal ulcer complain and antiacid therapy. We evaluated gastric pH, urine pH and urine acid output (mmol/hr.) after the test meal 3 of the 24 patients had recurrent ulcer semptoms and diagnosis. The urine acid output change was found-1,50 (-1 to -2) mmol/hr. at these patients and the 2 patients operated for duodenal ulcer, after the test meal. At the other hand 19 patients of this group the result was+1.378 mmol/hr. (0.25 to 6.5). The acid output after the test meal is the deviation of acid output from the basal amount, and it is always negative due to "post prandial alkalen tide". The urine acid output increased after the test meal at people with complete vagotomy and decreases if there is incomplet vagotomy. We applied revagotomy to 3 people and the test result was+1.33 (0.25 to 2.25) mmol/hr. Routine postoperative urine acid output evaluation is useful for controlling the completness of vagotomy. We believe that the test is easy to apply, simple and can be made without naogastric entubation.*

Key Words Vagotomy, duodenal ulcer, urine acid output, gastric function tests.

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Vagotomy and drainage procedures are the most used operations for duodenal ulcus operations with highest recurrence rate. (1) Incomplet vagotomy is mostly responsible for recurrence. (2) It is important to find out whether there is incomplet vagotomy or not. (3) For this routine post operative vagotomy control is advised (4). Up to know at all the test for the control of completness of vagotomy, one should use nasogastric entubation. The hollander test has serious practical disadvantages and side effects. The differences of method, interperation (5), the evaluation of gastrin level due to hypoglisemia which is not related to completness of vagotomy (1,6), the weak relationship between the insulin dosage and blood glucose level and gastric secretion change and the unrelaible postoperative gastric aspiration methods are the setbacks of the Hollander test. (7,8) At the Sham test, there is the disadvantage of nasogastric entubation and gastric aspiration (9).

Those disadvantages led researchers to find out simple and safe tests. At 1986 Dr. Ahmad found that the "postprandial alkalen tide" disappeared after vagotomy (1). At 1988 Dr. Johnson showed that there was a reverse linear corelation between gastric acid secretion and urine acid output. (10). Later he used test for the control of vagotomy. (4,11) In this study we controled the completness of vagotomy after Duodenal ulcus operations by urine acid output change test from the finding that

postprandial urine alkalen tide disappears after complet vagotomy.

PATIENTS and METHOD

GROUP I: 150 mgx2/day ranitidine was given to 10 normal volunteers for 2 days and the test was done after gastric acid supresion.

GROUP II: We applied the test to patients due to duodenal ulcus. Their ages were between 17-58, 17 were male and 7 were female. BTV was done to 22, PGV was done to 2 patients. Of the 22 patients with BTV 13 had antrectomy 3 had pyloroplasty, 6 had gastrojejunostomy. We had taken urine samples from the patients on the preoperative day and on the 5th. postoperative day. Postoperative samples were taken before the test meal and 1,2,3, hours after the test meal. At the preoperative period and before the postoperative test meal the gastric pH was measured with "Zinetics graphprobe ST" pH meter.

GROUP III: We applied postoperative test to 10 patients who had undergone inguinal hernia operations and didn't have any duodenal ulcus complain. They were at the same age and sex with the 2nd. group.

All the patients ceased smoking 48 hours and the fasted after midnight before the test day. The test was applied before and after the test meal at the 1st., 2rd., and 3rd. group. We used the same test meal that Dr. Johnson proposed. (4) We gave the test meal consisted of 100 gm yoghurt (5gm/100gm protein, 1,5gm/100 gm Lipid, 15gm/100gm carbohydrate), 50 gm Cheddar cheese (2gm/100gm protein, 43,5gm/100gm lipid), 50 gm white cheese (15,4gm/100gm protein, 18,2 gm/100gm lipid), 1 tomato (0.9gm/100gm protein, 28gm/100gm carbohydrate), 1 apple (0,3 gm/100gm protein, 11,9/100gm carbohydrate) and 2 slice bread, 4 branny biscuit and 2 glasses of water.

Urine samples were taken from the patients before the test meal (BTM), 1 hour after the test meal (ATM-1), 2 hours after the test meal (ATM-2), 3 hours after the test meal (ATM-3). Also the gastric pH measured with "Zinetics GrapHprobe ST.

Chemical Measurement

The chemical measurements were done at the biochemistry labaratory of our hospital by Jorgensen technic. At this method 10ml. Urine was acidified by O,IM HCI and as a result CO_2 were liberated from the bicarbonate source and phosphate deposites were dissolved. Then the sample was boiled to evaporate CO_2. 50 ml formaldehyte was added and cooled to room temperature, then the solution was titrated with 0.1 M NaOH until the pH reaches 7.4.

Calculations

Urine acid output is acid concentration x volume. The difference of urine acid output at BTM and ATM-1, ATM-2, ATM-3 gives the urine acid output change. a negative result indicates a more alkalen urine.

Intragastric pH measurement

These measurements were done with Zinetics GrapHprobe ST pH meter and NGS (18 F Gastric pH sump catheter) The pH were read by the aid of a temperature calibrated pH electrode and electronic LCD panel

Urine pH measurement

It was measured by C9-711 SCHOTT-GERATE at all groups of patients.

Statistical Analysis

The results were showed by median and range of values. The significance between the groups and the difference between the results of the groups were evaluated by Kruskal-Wallis variant analysis method. The statistics were done by Mann-Whitney-U test(U1,U2,U3)

Table I: Results of Intragastric pH measurement at Group-2

	Preop. Intra Gastric pH	Postop. Intra Gastric pH
1- BTV+ANTRECTOMY (n= 12)	2,03 (1,3-3.5)	4,98 (1,4-7,4)
2- BTV+GASTROJEJUNOST. (n= 4)	1,75 (1,7-1,8)	5,175 (4,8-5,7)
3- PGV (n= 2)	1,30 (1,3-1,3)	1,65 (1,2-2,1)
4- BTV+ PYLOROPLASTY (n= 3)	2,43 (1,8-3.3)	4,56 (3,7-5,8)
5- RECURRENT ULCER (n= 3)	2,83 (1,0-6,2) (Before Reop.)	4,00 (3,2-4,8) (After Reop.)

RESULTS

The results of group 2 was shown at table:1

The urine acid outputs and urine acid output changes BTM, ATM-1, ATM-2, ATM-3 periods were shown at table 3. We calculated the changes between the ATM-2 and ATM-3 periods and the basal value. 2 hours later the change was (+) at 19 patients. The median and the range were +1.378 (-0.25 to 6.5) mmol/hr. It was 1.313 (-1,25 to 5,75)mml/hr. after 3 hr. (Group 2A) At the 3 patients who had recurrent duodenal ulcus symptoms and at the 2 patients whose urine acid output change were (-) at the ATM-2 period. (Group 2B) the postoperative urine acid output change median and range were-1.5 (-2to-1)mmol/hr. 2 hours after the test meal. Revagotomy was done to 3 patients who had recurrent ulcer complaints and diagnosis. At those patients the values were +1.09(0.5 to 1.25)mmol/hr. and 1.33 (0.25 to 2.25) mmol/hr. at the ATM-2 and ATM-3 periods respectively. (Table 6) At group 111, the test was done at the 5th. Postoperative day. Gastric pH measurements were not done of the 10 patients. Postprandial urine pH were 7mmol/hr. at 3 patients. (Table 4). Urine acid output change values were-2.085 (-3 to-0.5)mmol/hr. ano -4.22 (-5.7 to -1.8)mmol/hr at the ATM-2, ATM-3 periods respectively. (Table 3- Table 6) All the findings were summurized at Table 6 and was shown at figure 1.

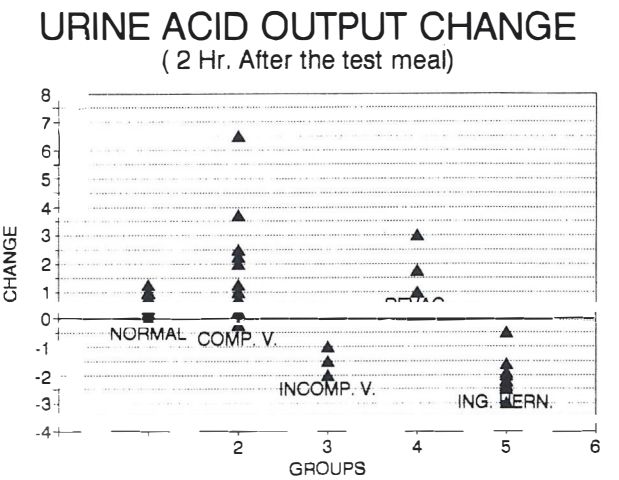

FIGURE 1: Change of urine acid output

DISCUSSION

This study was done by the guidance of the finding that postprandial urine alkalen tide dissappears after complet vagotomy. Postprandial alkalen tide is the alkalen shift of urine after meals. This is a physiologic answer can be explained with the seperation of karbonic acid to H+ and HCO_3. H+ ion and OH- group unites to make H_2O and secreted into the gastric juice. HCO_3 was secreted with proportion of acid formation. (1,12) The gastric venous blood was alkalen and consists large amount of HCO_3 H+ ion is secreted when the gastric acid secretion is stimulated. As a result the blood pH rises and the urine becomes alkalen (12). Those changes disappear after complet vagotomy. The test we used in this study can seperate complet and incomplet vagotomy. (4,11,12).

There are for reasons for the control of vagotomy (9,13) They are:

1) For the routin control of the tecnic,
2) To evaluate whether the patient has a tendency to recurrent ulcer, post operatively,

Table II: GROUP 2-CHANGE OF URINE ACID OUTPUT After Test Meal
*Incomplete vagotomy (Group 2B) [1st hr.p<0.01, at 2nd hr.p<0.001 at 3rd hr.p<0.001]

	Acid output (mmol/hr)				Change (mmol/hr)		
Name	BTM	ATM-1	ATM-2	ATM-3	ATM1-BTM	ATM2-BTM	ATM3-BTM
MA	11.25	11,5	11.75	11.75	0.25	0.5	0.5
O	8,0	8,5	8.75	9,0	0.50	0.75	1.0
MH	6.75	10,0	13,25	12,0	3.25	6.50	5.75
H	16,0	18.25	19.50	19.0	2.25	2.50	3.0
S	10,0	10,05	8,00	7,25	0.05	-2.00	-2.75*
HE	9.0	10.50	10.00	10.00	1.50	1.00	1.00
IB	8.25	7.75	6.75	7.00	-0.50	-1.50	-1.25*
KV	10.50	11.75	12.75	11.50	1.25	2.25	1.0
ZV	11.25	10.75	11.00	10.00	-0.5	-0.25	-1.25
A	3.75	6.25	5.75	6.25	2.5	2.0	2.5
FT	11.25	11.00	10.25	10.50	-0.25	-1.0	-0.75*
S	9.25	10.00	10.50	10.00	0.75	1.25	0.75
M	7.25	9.25	8.75	8.75	1.50	1.00	1.00
HK	10.5	10.75	11.00	11.00	0.25	0.50	0.50
YK	10.50	11.00	11.00	11.50	0.50	0.50	1.00
NS	10.25	10.50	10.75	11.25	0.25	0.50	1.00
IB	7.25	6.75	6.25	6.75	-0.25	-1.00	-0.50*
SA	5.80	10.50	9.5	9.75	4.70	3.70	3.95
CC	10.75	9.25	8.75	9.50	-1.75	-2.00	-1.25*
H	8.50	8.25	9.00	9.50	-0.25	0.50	1.00
HS	10.75	9.50	11.25	11.50	-1.25	0.50	0.75
EH	7.00	7.50	8.25	7.50	0.50	1.25	0.50
ND	12.00	12.50	13.00	12.50	0.50	1.00	0.50
A	10.75	10.00	11.00	11.25	-.75	0.25	0.50
After Revagotomy							
FT	10.25	11.50	13.25	12.50	1.25	3.00	2.25
IB	7.25	7.75	8.25	8.75	0.50	1.00	1.50
CC	9.50	10.75	11.25	9.75	1.25	1.75	0.2

3) To find out whether the semptoms are due to incomplet vagotomy,
4) To apply revagotomy, If one of the first reasons were (+).

At a study Dr. Ahmad measured urine pH with a digital pH meter and found out the alkalen tide (pH>7 at 3 of our patients. (Table 4) We couldn't find any urine pH>7 at any patient who was operated due to duodenal ulcus. The real alkalen tide is when the urine pH is>7. We conclude that postprandial urine pH measurement is not a reliable test for the evaluation of gastric function. We suggest that

Table III: REPAIR OF INGUINAL HERNIA Change of urine acid output

	ACID OUTPUT (mmol/hr)				CHANGE (mmol/hr)	
N.	BTM	ATM1	ATM2	ATM3	ATM2-BTM	ATM3-BTM
1	5.5	5.7	3.0	2.0	-2.5	-3.5
2	4.5	5.2	4.0	2.7	-0.5	-1.8
3	7.0	6.5	4.6	1.3	-2.4	-5.7
4	5.5	5.9	3.6	0.9	-1.9	-4.6
5	6.5	6.0	3.5	1.7	-3.0	-4.8
6	4.5	4.9	2.5	1.0	-2.0	-3.5
7	4.75	5.25	2.25	1.0	-2.5	-3.75
8	8.25	8.0	6.0	3.2	-2.25	-5.05
9	7.60	7.20	6.0	2.6	-1.6	-5.0
10	6.5	6.9	4.30	2.2	-2.2	-4.5

Table IV: URINE pH
Repair of inguinal hernia

	URINE pH			
N.	BTM	ATM1	ATM2	ATM3
1.	6.5	6,3	6.8	6.5
2.	6.8	6,5	7.1	7.0
3.	6.1	6,0	5.9	5.7
4.	6.3	6,3	6.5	6.4
5.	6.3	6,2	6.4	6.4
6.	5.2	5,7	5.5	5.9
7.	4.9	5,2	5.3	5.2
8.	5.8	6,0	6.2	6.1
9.	6.7	6,8	7.2	6.9
10.	6.5	6,9	7.3	6.8

Table V: GROUP 1-NORMAL VOLUNTEERS
URINE ACID OUTPUT (mmol/hr)

	ACID OUTPUT(mmol/hr)				CHANGE (mmol/hr)	
N.	BTM	ATM1	ATM2	ATM3	ATM2-BTM	ATM3-BTM
1.	-0.45	-0.25	-0.10	-0.15	0.35	0.30
2.	0.10	0.05	0.05	0.15	-0.05	0.05
3.	1.0	1.15	1.80	1.10	0.80	0.10
4.	2.25	3.20	3.50	2.00	1.25	-0.25
5.	0.00	0.05	0.15	0.10	0.15	0.10
6.	0.40	0.45	0.60	0.40	0.20	0.00
7.	2.5	2.6	3.0	1.1	0.50	-1.40
8.	1.5	2.05	2.30	1.0	0.8	-0.50
9.	-0.05	0.20	0.95	0.20	1.0	0.25
10.	0.05	0.60	1.00	0.50	0.95	0.45

urine acid output change is a more realistic test. Due to the tamponade systems of urine, changes occur at the urine acid raise before any PH change (10,11,12). The urine acid output decrease after a test meal disappears after complet vagotomy. (11) The (-) urine acid output change after the test meal (ATM-2) of patients operated for inguinal hernia shows that there is a decrease at urine acid output. This also supports the results of Dr. Johnson (11). (Tablo 6)

At group-1 where ranitidine treatment took place, postprandial acid output decrease was under pressure (Table 6). This shows that the rise of acid output after vagotomy is independent of the effects of vagotomy on the gastric emptying and intestinal transit time. (2,4)

The fasting gastric pH at normal people is between 0.8-1.87. A decrease of gastric pH is expected at patients with vagotomy. The fasting gastric pH of duodenal ulcer patients is between 1.5-1.98 and is not different from normal people. (14) At our study the fasting gastric pH of duodenal ulcus patients were 2.01 (mean value).

At group-2 at the ATM-2 period the urine acid output change was (+) at 19 patients. This positiveness show the acid output raise at duodenal ulcus patients with complete vagotomy. The 5 patients who had (-) post-prandial acid output change was accepted as having "Incomplete" vagotomy (Group 2B).

The results are significant, If we compare the results of complet vagotomy and incomplete vagotomy patients at every period. The p values are as follows: $p<0.01$ for ATM-1 period, $p<0.001$ for ATM-2 period, $p<0.001$ for ATM-3 period. If we compare the significant results between each other the results of ATM-2 period are more significant then ATM-3 period and ATM-3 period then ATM-1 period. (according to Mann-Whitney U test $U_2>U_3>U_1$)

Those results are in harmony the results of the control group who had undergone inguinal hernia operation, and this support the value of test If there is incomplete vagotomy.

If we compare the results of group 2A (complet vagotomy) and group 3 (control group) the results are significant ($p<0.001$). If we compare the results of group 1 (Ranitidine group) with group 3 the results were significant ($p<0.001$)

There is no significant difference between the results of group 1 and group 2A ($p>0.05$)

Our results and the other clinical researchers show the value of the test. (4,10,11)

If the patient has complet vagotomy the test meal dosn't make a decrease at the urine acid

Table VI: Urine acid output Change median and range after the test meal.

	GROUP 1 (n= 10)	GROUP 2A (n= 19)	GROUP 2B (n= 5)	GROUP 3 (n= 10)	REVAGOTOMY (n= 3)
2 Hr. after test meal	+0,59 (-0,05/1,25)	+1,378 (-0,25/6,5)	-1,50 (-1/-2)	-2,085 (-3/-0,5)	+1,091 (0.5/1.25)
3 Hr. after test meal	-0,09 -1,4/0,45)	+1,313 (-1,25/5,75)	-1,30 (-0,75/-2,75)	-4,22 (-5.7/-1.8)	+1,33 (0.25/2.25)

output. We reoperated 3 patient, who had incomplet vagotomy according to the test. We made revagotomy to 2 patients and revagotomy+Roux-en-Y GJ due to alkalen reflus gastritis. After vagotomy urine acid output changes were (+). We resolved to observe the other 2 patients that had incomplet vagotomy due to our test, because they didn't have any symptom. There is a discordans between the pH values of 5 patients with incomplet vagotomy and their urinary acid output changes (Table 7). At group 2A the gastric pH value was 4.24(1.2-7.4) unit and at group 2B the pH value was 4.14 (1.0-6.2) unit. There is no significant difference between those two results. (p>0.05)

Gastric pH determination has some disadvantages such as; the alkalen reflux effects the results, the necessity for nasogastric entubation, the tube may pass through the stoma and alter the results. So it should be applied by the aid of scopy. Also there is a pH difference between the gastric secretion and the gastric mucosa (in the stomach gastric secretion pH>mucosal pH; in the duodenum it is the reverse.) In order to obtain a real gastric pH value the tip of the tube should be attached to the mucosa, which is impossible. (15) Those leads us to unreliable pH results which can not help to determine the completness of vagotomy.

Table VII: Discordans between intragastric pH values and urine acid output at Group 2B (Incomplete Vagotomy)
! : Recurrent ulcer (Preop. intragastric pH measuremenets were made after 3 to 7 years of the first operation
+: After Revagotomy

GROUP 2B (INCOMP. VAG.) OPERATION	PREOP. INTRA-GASTRIC pH	POSTOP. INTRA-GASTRIC pH	CHANGE OF Acid Output at 2 hr.
1-BTV+ANTRECT.	1,3	6,5*	
2- BTV++GJ	1,8	5,7*	-2,75
!3- BTV+GJ	1,3	3,2+	-1,25
!4-BTV+GJ	1,0	4,0+	-1,0
!5-BTV+ANTRECT.	6,2*	4,8+	-1,0
			- 0

Urine pH measurements are also not effective, since there are tamponade systems as indicated. As a result the acid output change occurs before the pH change. Our results at group 2 and group 3 fails to support the results of Dr. Ahmad. We were unable to obtain urine pH change after the test meal at most of our patients at group 2, and pH values >7, which indicate real alkalen tide.

As a result we can suggest that urine acid output measurements can be used as a routine test for the control of completness of vagotomy, for the evaluation of symptoms of patients with recurrent duodenal ulcus and to determine whether a revagotomy is needed or not.

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