Sodium content and neutralising capacity of some commonly used antacids

Patients suffering from hepatic failure, renal failure, and occasionally heart failure may require treatment regimens needing strict control of sodium intake. The incidence of dyspeptic symptoms in these conditions is high so that they are frequently treated concomitantly with antacids. Some antacids contain large quantities of sodium,^{1,2} sufficient to complicate seriously any therapeutic regimen requiring salt restriction.

Information on the theoretical sodium content of *BP* and *BPC* preparations is readily available, but only one proprietary antacid preparation states the sodium content on its statutory product data sheet. To make this information freely available, we have measured the sodium content of 15 liquid and 13 tablet antacids which are in common use in our health district. The neutralising capacity of each antacid was also measured so that a comparison of in vitro neutralising capacity and sodium content can be made.

Methods and results

Neutralising capacity was measured by a modification of the method of Fordtran *et al.*³ Sodium content was measured by flame photometry. The results are shown in the table as a mean of at least three estimations.

Sodium content and neutralising capacity of some commonly used antacids

	Sodium content	Total daily sodium consumption from the antacid (mmol)*	Neutralising capacity per 10 ml dose†
<i>Liquid Antacids</i>			
	mmol/10 ml dose		ml/10 ml dose
1 Magnesium Carbonate Mixture <i>BPC</i>	9.8	59	202
2 Synergel	7.7*	23	428*
3 Liquid Gaviscon	6.3	50	55
4 Magnesium Trisilicate Mixture <i>BPC</i>	6.3	38	220
5 Aluminium Hydroxide Gel <i>BPC</i>	1.0	6	255
6 Aludrox-SA	0.7	3.5	301
7 Antasil	0.6	3.6 E	428
8 Mucaine	0.5	2.5	294
9 Maalox	0.5	4	233
10 Polycrol Gel	0.4	1.2	135
11 Polycrol Gel Forte	0.4	1.2	230
12 Mylanta	0.3	1.2	220
13 Asilone Suspension	<0.1	<1	301
14 Asilone Gel	<0.1	<1	194
15 Magnesium Hydroxide Mixture <i>BP</i>	<0.1	<1	258
<i>Tablet antacids</i>			
	mmol/tablet		ml/tablet
16 Gaviscon	1.41	11.3	15
17 Nulacin	0.46	3.7 E, C	93 C
18 Actal	0.38	3.0 E	84
19 Polycrol	0.23	1.4	105
20 Polycrol Forte	0.23	1.8	100
21 Magnesium Trisilicate Compound <i>BPC</i>	0.18	1.4 E	45
22 Gelusil	0.18	1.4 E	65
23 Asilone	0.17	1.4	105
24 Aludrox	0.10	0.8	142
25 Maalox	0.04	0.3	240
26 Antasil	0.04	0.3 E	204
27 Prodexin	<0.01	<0.1 E, C	186 C
28 Titralac	<0.01	<0.1 C	87 C

*Result expressed per sachet since this preparation is presented in single dose sachet (20 g, approx 15 ml) and the physical properties are such as to make accurate pipetting impossible.

†Total daily consumption of sodium calculated from manufacturer's maximum recommended dose.

‡Neutralising capacity = millilitres of 0.1N HCl neutralised in vitro in 2 h at 37°C by 10 ml liquid antacid or 1 tablet at stirring rate 120 rpm.

C = Contains calcium as active ingredient.

E = Estimated; where no upper dose limit is recommended, consumption is estimated on basis of three 20-ml doses of liquid antacid, or, for tablet antacids, eight tablets per day. Calculations for *BPC* preparations are similarly based.

Comment

Patients with hepatic or renal failure frequently require dietary sodium restriction to maintain fluid balance. Most such dietary regimens limit sodium consumption to about 40 mmol per day, but it is occasionally necessary to reduce this to 20 mmol per day.

Some antacids (see table, 1-4 and 16) contain such large amounts of sodium that the sodium consumed from that source would soon exceed the daily allowance of a 40 mmol/day regimen. Note that Synergel contains a significantly greater concentration of sodium than Liquid Gaviscon, but the manufacturer's maximum recommended dosage for their product is different, so that the daily sodium consumption from Liquid Gaviscon is more than twice that from Synergel. This factor may be of importance for tablet antacids, where, although the total sodium content per tablet is usually small in comparison with liquid antacids, the manufacturers frequently fail to indicate an upper limit on the number to be consumed (E).

The neutralising capacity of different antacids varies widely. Although Synergel contains a very high sodium concentration, it at least has the potential advantage of a high neutralising capacity—whereas Liquid Gaviscon (also high sodium) has a tiny neutralising capacity.

For some liquid preparations (see table, 5-12) sodium salts are present in chemically significant amounts as contaminants of the active ingredients, which may themselves have been prepared from other sodium salts. There is no designated limit of impurity with respect to sodium. Nevertheless, our results indicate that this contamination is present in quantities small enough to be clinically insignificant except if consumed in unusual quantities by patients on the strictest salt-free regimens.

¹ Bleifer, K H, Belsky, J L, and Bleifer, D J, *New England Journal of Medicine*, 1959, **261**, 604.

² Rimer, D G, and Frankland, M, *Journal of the American Medical Association*, 1960, **173**, 995.

³ Fordtran, J S, Morawski, S G, and Richardson, C T, *New England Journal of Medicine*, 1973, **288**, 923.

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Familial hypercholesterolaemia with alpha₁-antitrypsin deficiency

α_1 -Antitrypsin deficiency (PiZZ) has been recorded in association with pulmonary emphysema¹ and juvenile liver cirrhosis² but not with genetically determined conditions. We report a patient with familial hypercholesterolaemia associated with obstructive lung disease with α_1 -antitrypsin deficiency PiZZ. Such an association has not been described.

Case report

A 54-year-old man presented with the sudden onset of hemiparesis and aphasia, which recovered progressively. For 15 years he had had chronic bronchitis, emphysema, and severe progressive exertional dyspnoea. At the age of 34 he had been told that his serum cholesterol concentration was raised and he had been treated initially with a diet and latterly with cholestyramine. Three years before admission he had had renal colic and a stone had been shown on intravenous pyelography. His father and his three brothers had all died suddenly in their 20s from an illness characterised by precordial pain, while both of his paternal aunts had died from cerebral thrombosis, one in her 20s, the other in her 50s. Examination showed many xanthelasma, corneal arcus, and several xanthomas on both Achilles tendons. The thyroid was not palpable. The chest was barrel shaped, hyperresonant on percussion, with prolonged expiration and widespread rhonchi. A slightly tender liver was felt 2 cm below costal margin. Peripheral pulses were palpable, and the optic fundus showed arteriovenous nicking and slight arterial narrowing.

Investigations showed: haemoglobin 17.9 g/dl, packed cell volume 56.8%, normal liver function tests, albumin 40.6 g/l, α_1 -globulin 0.7 g/l, α_2 -globulin 10.5 g/l, β -globulin 8.0 g/l, γ -globulin 9.8 g/l, urate 0.24 mmol/l (4.1 mg/100 ml), cholesterol 8.66 mmol/l (377 mg/100 ml), triglycerides 1.13 mmol/l (100 mg/ml). The results of determinations in 1955 had been: cholesterol 15.64 mmol/l (610 mg/100 ml), and in 1976: cholesterol 12.30 mmol/l (480 mg/100 ml), triglycerides 0.89 mmol/l (79 mg/100 ml).

Lipoproteinogram: α -lipoprotein 23.4%, pre- β - plus β -lipoproteins 76.6%. Very prominent pre- β -lipoprotein with normal triglycerides was interpreted as a "sinking pre- β ." Po₂ was 5.8 kPa (43.3 mm Hg), Pco₂ 4.9 kPa

(37 mm Hg), pH = 7.42, HCO_3^- 24 mmol(mEq)/l, vital capacity 50% of "normal", forced expiratory volume in 1 second (FEV_1) 22% of "normal", $\text{FEV}_1/\text{vital capacity}$ 44%. ECG showed sinus tachycardia and right atrial hypertrophy. A chest x-ray film showed hypertranslucency especially on the left. Serum trypsin inhibition capacity was 0.294 mg trypsin inhibited ml serum (normal range 1.56 ± 0.27) and Pi typing by the Fagerhol acid starch method followed by crossed antigen-antibody electrophoresis³ showed a ZZ pattern.

Family study—Wife (47 years old): Pi MZ, cholesterol 7.58 mmol/l (295 mg/100 ml), triglycerides 0.80 mmol/l (70 mg/100 ml). Son (26 years old): Pi MZ, cholesterol 5.74 mmol/l (224 mg/100 ml), triglycerides 1.74 mmol/l (153 mg/100 ml), prominent β and pre- β . Daughter (13 years old): Pi MZ, cholesterol 7.17 mmol/l (280 mg/100 ml), triglycerides 1.02 mmol/l (90 mg/100 ml). Daughter (24 years old): Pi MZ, cholesterol 4.71 mmol/l (184 mg/100 ml), triglycerides 0.94 mmol/l (83 mg/100 ml).

Discussion

The clinical picture, family history, serum lipid values, and lipoproteinograms in this patient were consistent with the diagnosis of familial hypercholesterolaemia. Concentrations of cholesterol below 20.7 mmol/l (800 mg/100 ml) and survival beyond 30 years point to an heterozygous hypercholesterolaemia, with a coincidental severe chronic obstructive lung disease with α_1 -antitrypsin deficiency Pi ZZ.

α_1 -Antitrypsin (Pi system) is genetically determined by multiple autosomal codominant alleles; a genetic linkage has been described between the Pi system and GM—the system that codes for the heavy chain of the IgG molecule.⁴ Further linkage studies of Pi system with other markers such as blood group specific components and hapto-globin serum groups have proved negative and an association with other genetically determined diseases has not been reported. The association of familial hypercholesterolaemia with α_1 -antitrypsin deficiency type ZZ in our patient raises the hypothesis of genetic linkage or association between the Pi system and the autosomal dominant determination of lack of low-density lipoprotein cellular receptors in patients with familial hypercholesterolaemia.⁵

We think that this possibility warrants further evaluation. Study of the distribution of Pi types in patients with familial hypercholesterolaemia and appropriate linkage studies should test this hypothesis.

¹ Eriksson, S, *Acta Medica Scandinavica*, 1965, **177** suppl, 432.

² Sharp, H L, et al, *Journal of Laboratory and Clinical Medicine*, 1969, **73**, 934.

³ Geada, H, Albino, J, and Manso, C, *Human Genetics*, 1976, **32**, 109.

⁴ Gedde Dahl, J R, et al, *Annals of Human Genetics*, 1972, **35**, 393.

⁵ Goldstein, J L, and Brown, M S, *Journal of Biological Chemistry*, 1974, **249**, 5153.

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Detection of renal artery stenosis by measuring urinary N-acetyl-beta-D-glucosaminidase

Formidable logistic problems exist in detecting within the vast hypertensive population those patients with underlying renal disease, particularly renal artery stenosis.¹ Screening by intravenous urography or isotope renography results in prohibitive cost and considerable inconvenience to patients, while the appreciable morbidity caused by renal arteriography adds to the problems of selecting patients for investigation.²

N-acetyl- β -D-glucosaminidase (NAG) is a renal tubular enzyme, the urinary activity of which is increased in various nephropathies, including acute renal failure, transplant rejection, and glomerulonephritis.^{3,4} We have investigated the estimation of NAG as a

screening test for underlying renal disease in hypertension and describe here our findings in patients with renal artery stenosis.

Methods and results

We studied 14 patients with arteriographically proved renal artery stenosis. In 11 patients the results of more than one NAG estimation were available, and the mean activity was then used in expressing the results. The enzyme activity of a casual urine sample was measured by an automated fluorometric assay technique.⁵ Twenty-four-hour urine collections are unnecessary as variations due to changing urine flow are largely eliminated by factoring the enzyme activity by the creatinine concentration of the sample.⁴ NAG activity varies appreciably with age in healthy people and a value more than one standard deviation above the appropriate age-corrected mean has been accepted as a significant increase.⁵

The mean value for urinary NAG in patients with renal artery stenosis was significantly higher than that in 180 controls (191 and 76 nmol/h/mmol creatinine respectively, $P < 0.01$). Urinary NAG activity was raised in 10 of the 14 patients, in some cases to very high values (see figure).

Urinary NAG and renal artery stenosis.

Other factors need to be considered in two of the four patients with renal artery stenosis who had normal urinary NAG activity. Thus one patient had the typical intravenous urographic and renographic appearances of renal artery stenosis in 1971 (confirmed by angiography), but on reinvestigation five years later the intravenous urogram and renogram were normal. It was then, when there was no evidence of functionally significant renal artery stenosis, that urinary NAG was normal. The other patient had two arteries supplying the right kidney, of which only one had stenosis. Three patients with raised urinary NAG activity underwent nephrectomy. Urinary NAG activity fell to normal in each case after operation.

Comment

Thus urinary NAG estimation detected 10 of the 12 patients with stenosis of a main renal artery sufficient to affect renal function as judged by urography and renography. For this measurement the urine sample is collected at the general practitioner's surgery, and it is as convenient for the patient as testing for proteinuria (which by contrast is a poor guide to renovascular disease in hypertensive patients² and was present in only two of the 11 patients in whom it was sought). Measuring NAG is simple, cheap, and automated, each estimation costing about 20p compared with an estimated £35 for outpatient intravenous urography at this hospital.

Techniques for evaluating the functional importance of a renal arterial stenosis and predicting the response to surgery continue to become more complex and expensive. This emphasises the need for a simple but reliable screening test that could be applied to large numbers of hypertensive patients to select those in whom detailed investigation would be more likely to yield positive findings. Our results suggest that NAG estimation may fulfil such a role, and we