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GASTRIC ACID SECRETION USING PENTAGASTRIN: DOSE-RESPONSE STUDIES

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Summary

The results of gastric stimulation using varying doses of pentagastrin in twenty-five Nigerians (twenty cases of duodenal ulcer and five controls) are presented. Doses used were 4, 6, 8 and 10 μg/kg bodyweight. The optimal response was obtained using 6 μg/kg bodyweight in the test cases while the maximum acid output (MAO) was 15.14 mEq/hr (19 mEq/hr in males, 12.50 mEq/hr in females). The recommended dose for optimal response in Caucasians is 6 μg/kg bodyweight which correlates with the dose in our patients. However, the maximum acid output at this dose is higher in Caucasians.

Introduction

The existence of a high prevalence area of duodenal ulcer on the West Coast of Africa and in particular Nigeria and Cameroon has been confirmed. In contrast to the pattern in Caucasians, duodenal ulcer and its complications show marked similarities in Indians and Africans in whom fibrosis and early gastric outlet obstruction is common while the incidence of haemorrhage and perforation is much lower (Tovey & Tunstall 1975).

Results of gastric acid stimulation using histamine acid phosphate also show a marked racial difference with high figures among the Caucasians and lower ones in Africans, Indians and Chinese (Lawrie, Smith & Forest, 1964; Raju *et al.*, 1965; Fung, 1968; da Rocha-Afodu & Adesola, 1972; Solanke & Lewis, 1976).

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Pentagastrin, a synthetic derivative of gastrin is now widely used in the routine test of gastric acid secretion but studies have been done mostly in Caucasians, (Johnston & Jepson, 1967; Mason & Giles, 1969) though a study had been reported from Lagos (da Rocha-Afodu & Adesola, 1973). An attempt is made in this study to determine the optimal dose of pentagastrin required for maximum gastric acid secretion and the maximum acid secretion in Nigerians in Ibadan.

Materials and methods

Twenty-five patients were studied. Twenty of them had clinical and radiological evidence of chronic duodenal ulcer which was later confirmed at operation. Five acted as controls and consisted of patients with hernia, hydrocele and haemorrhoids. The control patients had no history or clinical evidence of duodenal ulcer. The age, sex and bodyweight of each patient were recorded. Each patient was subjected to four tests on four consecutive days using pentagastrin at doses of 4, 6, 8 and 10 μg/kg bodyweight respectively. At 1800 h on the evening before the test, a radio opaque nasogastric tube was passed into the stomach and its position checked by plain radiography of the abdomen. A light meal was given at 2000 h and the patient was thereafter fasted overnight. At 0800 h on the day of test, the stomach content was thoroughly aspirated. Basal secretion was then collected for 30 min.

Pentagastrin was then given subcutaneously at 0830 h at the appropriate dose and gastric secretion collected at 15 min interval for 1 h, i.e. four specimens. Each specimen was measured

for volume, pH level, and titrable acidity using 0.01N NaOH with 0.04% bromothymol as indicator. The maximal acid output (MAO) in mEq/hr was calculated for each dose by multiplying twofold the sum of the acid output in the highest two consecutive 15 min specimens (Baron, 1963). There were therefore 4 MAOs for each patient.

Statistical analysis

For each of the two groups, test cases and controls, the variables of age, bodyweight and MAO were summarized using the mean and the standard deviation or standard error. One way analysis of variance technique was employed to compare the mean MAO among the four dose levels. To correct non-normality observed in the distribution of the MAO, the original data were transformed into common logarithmic units before the analysis of variance was performed. The estimated mean log output was later transformed back to the original units to yield geometric means.

Results

Table 1 shows the parameters of age and bodyweight among the cases and controls. For age, the two groups respectively averaged 36.45 and 36.49 years, while the corresponding mean values for bodyweight were 57.36 and 58.62 kg.

TABLE 1. Parameters of age and bodyweight

		Age (years)	Bodyweight (kg)
Cases	Mean	36.45	57.36
	s.d.	10.05	7.91
	n	20	20
Controls	Mean	36.40	58.62
	s.d.	6.50	8.01
	n	5	5

Table 2 shows the mean MAO in log units and the corresponding geometric mean at each dose level. Figure 1 displays the latter set graphically. Among the test cases, the MAO shows a maximum at a dose level of 6 μg/kg bodyweight. Among the controls however there was a consistent rise from the lowest stimulating dose of 4 μg/kg bodyweight to the highest stimulating dose of 10 μg/kg.

TABLE 2. Mean and standard error* of maximum acid output in common logarithmic units. Geometric means are shown in brackets

	Dose levels			
	4 μg	6 μg	8 μg	10 μg
Cases				
Mean	1.14 (13.80)	1.18 (15.14)	1.09 (12.30)	1.02 (10.47)
s.e. mean	0.07	0.07	0.07	0.07
No. of observations	20	19	19	19
Controls				
Mean	0.50 (3.16)	0.64 (4.37)	0.90 (7.94)	0.99 (9.77)
s.e. mean	0.22	0.24	0.20	0.22
No. of observations	6	5	7	7

*Estimated from the analysis of variance tables

However, Table 3 for test cases and controls, indicates that the mean MAO does not differ significantly among the four dose levels.

Discussion

In a similar study done at Lagos, Nigeria, the optimum dose of pentagastrin which stimulated maximum secretion was found to be 8 μg/kg bodyweight (da Rocha-Afodu & Adesola 1974). Studies among Caucasians however showed the standard dose to be 6 μg/kg bodyweight (Johnston & Jepson, 1967, Multicentre Pilot Study, 1967). In this series, we found the optimal dose to be 6 μg/kg bodyweight. In the series from Lagos six patients (two cases and four controls) were studied, whereas, in this series twenty-five patients (twenty cases and five controls) were studied. It may be tempting therefore to infer that, in view of the large number of patients studied, the dose of pentagastrin needed for optimal secretion in Nigerian patients is 6 μg/kg bodyweight. This however would have to await studies from other centres. The mean MAO for the test cases was 15.4 mEq/hr. This is markedly lower than the figures for Caucasians (Multicentre Pilot Study, 1967) and slightly below the figures from Lagos (da Rocha-Afodu & Adesola 1973). However if the test cases were analysed according to sex, the mean maximum output was 19 mEq/hr for males and 12.50 mEq/hr for females. The female subjects among the test cases were few and not much reliance can be placed on this figure though experience have shown that men tend to secrete more acid than

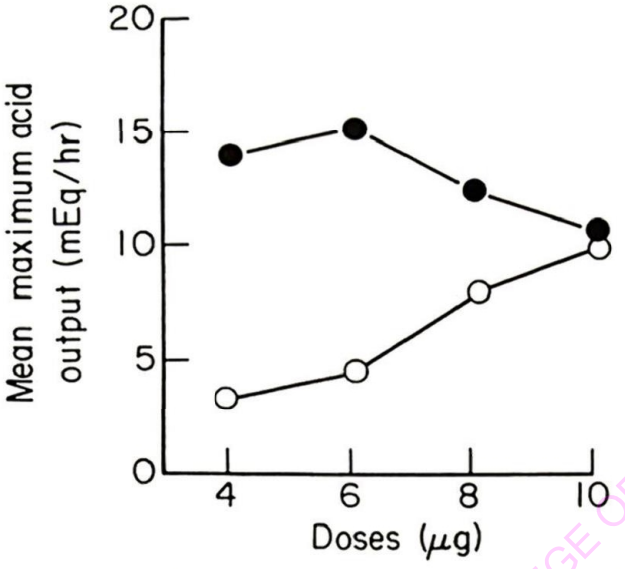

FIG. 1 Mean maximum output at each dose level. ●, cases; ○, controls.

TABLE 3. Analysis of variance to compare the mean maximum acid output at the four dose levels (in common logarithmic units)

Source of variation	Degrees of freedom	Sum of square	Mean square	Variance ratio *F*	Probability *P*
Cases					
Between doses	3	0.25	0.08	0.81	0.05
Residual	74	7.64	0.10		
Total	77	7.89			
Controls					
Between doses	3	0.99	0.33	1.18	0.05
Residual	21	5.81	0.28		
Total	24	6.80			

women (Baron, 1963). The higher levels of MAO in Western countries may be due to differences in weight and body build and the consequent higher dosages of pentagastrin used. The low level of acid in Nigerians may also explain the relatively less common incidence of haemorrhage and perforation which are not unconnected with high levels of acid.

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