 behaviour varies in a way which may influence the pattern of gastro-oesophageal reflux.

The second point which must be discussed relates to the analysis and interpretation of their results. As correctly discussed, the use of correlation coefficients is inappropriate for examining reproducibility and difference analysis should have been diagrammatically stated and in the text, the differences between the two results increase as the mean result increases - that is, the difference is proportional to the mean. Thus the differences should be analysed after logarithmic transformations of the results and expressed either as a ratio or a percentage difference and not as absolute values as used here. Using this method we showed a 95% chance that a second reflux index would be between 0.27 and 3.7 times the first.

Vandenplas et al's unlogged results for reflux index give a 95% chance of a second study having a result within 8% of the first (as shown in their Fig 3). This would mean that a reflux index of 10% chance would be followed by a second study with a result anywhere between 2% and 18%. Although none of the children studied had results which changed from normal to abnormal, this potential variation is considerable and does not support the contention that the pH study is 'highly reproducible.' If the logged results had been used the difference would have been a proportion rather than an absolute value and thus less with lower reflux indices and more with higher ones.

The data presented show that considerable differences may occur in 24 hour oesophageal pH studies in children even when restrictions are placed on their behaviour. Our own study suggests that such restrictions these differences are even greater. This must be taken into account both clinically and in trials of treatment.

Reply

Sr., — The comments of Dr Hampton and Dr MacFadyen are very interesting and confirm our opinions. The study by Hampton et al is a logical continuation of our study: once pH data had been shown to be reproducible, all factors of possible influence being standardised (our study), a second study was necessary to analyse how much power related factors influence pH data (Hampton study). It is logical that data recorded under these study conditions are less reproducible.

The study on the reproducibility shows that if data are clearly within normal ranges there is a good possibility of the results being comparable when recorded a second day. The same is true if data are clearly 'abnormal,' although differences between two consecutive recordings might be higher. Schapira et al and MacFadyen confirm this in their letter: if the logged results had been used, there would be less difference with lower reflux indices and more with higher ones. So, the conclusion with unlogged or logged results is exactly the same.

We knew of Bland's book.1 It is our opinion, however, that it is preferable to compare data in the same way they are presented. Taking logarithmics might be mathematically correct, but pH monitoring data for clinical purposes are presented as such. Reproducibility also depends on the material that is used: comparability of simultaneous recordings with two identical or similar recording electrode is much better than the same patient (r=0.90 for the % time pH <4 reflux index) is statistically inferior to the comparability obtained with two glass electrodes (r=0.99 for the reflux index). Therefore, the results of the reproducibility study of Johnsson and Joelsson are excellent and comparable to ours: they report a correlation coefficient of 0.87 for two consecutive 24 hour recordings with antimony electrodes.

We are surprised to have to point out that the present study is not reproducible, as it is our finding that normal ranges of physiological gastro-oesophageal reflux have been shown to vary 'quite a lot' in large groups of asymptomatic controls.

The percentages for the reflux index in a 'normal' population were shown to vary from 0 to 10% (p<0.05).

As we stated in a recent review article,1 the answer to the simple question which patients are 'normal' or 'abnormal' is clear cut in only a few cases. There is a considerable overlap between 'normal' and 'pathological.'

The results of our study show that there are only a few problems which might be expected in the interpretation of, for example, a reflux index of <5% or >15%, since the risk that the interpretation of the results of a second day's recording would be different is minimal. There remains a problem for those with reflux indices of 3-7% and we believe that this is the 'all' or 'none' interpretation of pH monitoring data by a computer using a 'cut off' limit. For a software program pH 3-99 is 'abnormal' and pH 4-01 is 'normal.' For the patient, however, there is no difference at all. Therefore, we think that the development of new parameters, such as the 'oscillatory index' is of great interest. This parameter calculates the percentage of the time the pH oscillates around pH 4-01 that is, between pH 3-7% and 4-01 and therefore quantifies the all or none consequences of the application of a cut off limit.

Our results show that 24 hour pH monitoring data are 'highly reproduceable.' When data are normal (and the patient is related more to the use of a cut off limit than to patient or technique related factors they should be interpreted with care, and use of the percentiles as well as the oscillatory index might be very helpful.


Reproducibility of oesophageal pH monitoring

Sr., — We were interested to see the data which Vandenplas et al presented on the reproducibility of oesophageal pH monitoring used for the diagnosis of gastro-oesophageal reflux in young children.1 There are, however, two ways in which our own, similar study differs from theirs which we think merit discussion. The first is that Vandenplas et al document the child's meal times, position, and behaviour on the first day and exactly mimics this on the second day. In our study we did not impose such limitations with a view to gaining a better understanding of the likely variation in the amount of gastro-oesophageal reflux occurring from day to day. In the normal situation

(PRA) and plasma concentration of arginine vasopressin (AVP) in this group. No responses to albumin infusion were noted in six of 15 patients (group B). These patients had high ANF and low PRA, suggesting a relative volume overload.

It is well known that patients with liver cirrhosis are not representative of an entire group. There are at least two mechanisms leading to sodium and water retention and thus ascites. Patients with decreased effective intra-vascular volume have an activated sympathico-adrenal and renin-angiotensin-aldosterone axis, raised vasopressin level, and decreased plasma concentration of ANF (underfilling theory). In contrast, volume overloaded patients have decreased vasconstrictor and increased vasodilator hormone activity and flow theory); the renal sodium retention in these cases represents a primary event due probably to intrarenal microcirculatory changes.

The patients presented here show characteristics of both causes of liver cirrhosis. It is of interest, however, that only patients with signs of underfilled effective intravascular volume provided an adequate response to intravenous albumin. Albumin induced centralisation of the kidney results in increased diuresis and sodium excretion and in normalisation of the activated vasconstrictor and sodium retaining hormone systems. These data may give a better insight into the patient's sodium and water retention and also into the mechanism of the effect of albumin infusion in liver disease.
Reproducibility of oesophageal pH monitoring.

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