Monitoring oesophageal pH

The association between symptomatic gastro-oesophageal reflux and acidity was clearly recognised four hundred years ago, but how much has modern technology helped define this relationship? Recording of intraluminal acidity in man with a swallowed glass electrode was reported by Rovelstadt 1952. To demonstrate gastro-oesophageal reflux others made measurements of the pH gradient across the cardia by withdrawing a glass electrode from the stomach into the oesophagus, after acidifying the gastric contents with 0.1 M hydrochloric acid. Subsequently a variety of physical procedures such as deep breathing, coughing, changes in posture, straining and the Valsalva and Mueller manoeuvres were used to induce reflux. Such short time recordings, even when combined with provocative manoeuvres, proved but a rough and inaccurate means of detecting pathological degrees of acid reflux.

The development of composite electrodes incorporating the reference electrode, made possible prolonged recording of oesophageal pH and this method was developed in Britain. It enabled not only quantification of oesophageal acid exposure, but identification of the times of day or night at which reflux is most common, together with identification of provoking factors. This has been greatly facilitated by the more recent use of portable compact recorders worn by the patient, thus enabling him to pursue his everyday activities during the recording. Computer analysis has saved time and tedium of analysing the records and has greatly facilitated the routine use of this equipment in gastroenterological units which do not have a large technical staff. In spite of the wealth of sophisticated equipment now available there is no consensus of opinion about how best it should be deployed, or what criteria are most valuable in distinguishing physiological from pathological reflux. These problems have been addressed by de Caestecker and his colleagues from Edinburgh in this issue of Gut.

pH probes and tethered radio pills are used to record oesophageal pH and there is now an increasing range of equipment available commercially. There is probably little to choose between the two systems, both of which now provide stable recordings of high fidelity. The probe is easier to pass in patients who have difficulty in swallowing and, because of its relative stiffness, is less likely to be vomited back. In position the radio pill causes marginally less discomfort, because the nylon tether is thinner. In one comparative study radiotelemetry provided adequate records in 78% of tests compared with 93% for an antimony glass micro-electrode probe, the difference being accounted for by more frequent signal loss and patient's intolerance of the radio pill. Units with long experience of radiotelemetric
recording of oesophageal pH have a much lower failure rate.\textsuperscript{10-13} However, which suggests that familiarity with a particular method is more important than the method itself in achieving satisfactory results.

Occasional heartburn is common in the community and two surveys have indicated that 25\% of the adult general population experience the symptom at least once a month.\textsuperscript{15,16} It is not therefore surprising that 24 hour oesophageal pH monitoring has shown some degree of gastro-oesophageal reflux to be a physiological occurrence.\textsuperscript{7-17} The problem of how to discriminate between pathological and physiological reflux presents difficulty, as physiological reflux has not yet been clearly delineated. Ambulatory oesophageal pH monitoring with the patient engaged in everyday activities may enable identification of activities and events which are particularly likely to provoke reflux. This method has clearly shown that both physiological and pathological reflux are significantly greater when the subject is ambulant, than when confined to a hospital bed and its immediate environment.\textsuperscript{10} Hence normal levels of oesophageal pH have had to be redefined in the light of the conditions of the test.

This raises the question of to what extent should conditions be standardised during the period of monitoring and here there is no uniformity of opinion. Some allow the patient free choice of diet whilst others, at the risk of impalatability, rigidly standardise meals taken. Acidic foods such as fruit juice, fruit based products, tea and yoghurt, are often avoided,\textsuperscript{18} but as the Edinburgh group point out, pH change is so transitory during their passage through the oesophagus that the effect on overall 24 hour acidity is minimal. Avoidance of smoking and alcoholic drinks during pH recording scarcely seems logical if realistic assessments are to be made. Even with standardisation of all these factors it is questionable whether the reproducibility of acid exposure would be increased. In general, the more restrictive the conditions of the test the lower and less representative of normality the degree of acid exposure is likely to be. As yet, there is no clear evidence that such rigid standardisation is valuable and it would seem more useful to follow the patient’s usual pattern of reflux under his usual living conditions.

Oesophageal mucosal damage is influenced not only by the acidity of refluxed material, but also by the duration of periods of acid exposure, which is determined by the efficacy of oesophageal clearing. It is usual to measure the number of spikes of acidity which indicate the frequency of reflux episodes and the duration of the resulting period of high oesophageal acidity; the better oesophageal clearing, the shorter will be the duration of these spikes. It has been suggested that a duration of more than five minutes indicates impaired clearing.\textsuperscript{19,20} Thus oesophageal pH recording reflects oesophageal motor activity and its disturbance.

A major difficulty in the evaluation of any scoring system is to decide what criteria to use for normality in view of the prevalence of mild symptoms in the general population on the one hand, and the fact that symptomatic gastro-oesophageal reflux may occur in the absence of oesophagitis on the other. To discriminate between physiological and pathological gastro-oesophageal reflux a scoring system was devised by DeMeester and his colleagues\textsuperscript{21} based on six components of the 24 hour oesophageal pH analysis. These comprised the number of reflux episodes to below pH 4, the total duration of pH below 4, the duration of pH greater than 4 in the upright
position and in the supine position, the number of reflux episodes of more than five minutes duration and the duration of the longest reflux episodes in the 24 hours. Calculating the 24 hour pH score is a matter of some complexity, but in their hands this gave a 90-3% sensitivity and a 90% specificity. A simpler frequency-duration index devised by multiplying the frequency of episodes of reflux by the cumulative duration of periods of high acidity, each measured during a 24 hour recording, was described by Branicki et al, and appeared to provide good discrimination between normal subjects and patients with symptoms of reflux during the day; it was less discriminating at night because nocturnal reflux was minimal in many patients. Using cumulative acid exposure alone and without reference to reflux events, Stanciu et al found a pH threshold of 5 to give best separation between normal subjects and patients with reflux. Vitale et al, however, found a pH threshold of 4 to be more discriminating than 3, 5, or 6. Using an analysis based on frequency of reflux events and cumulative pH exposure analogous to the frequency during ratio of Branicki they found a sensitivity of 76% and a selectivity of 91% in the diagnosis of pathological reflux. Hence there is a general agreement that the frequency of reflux episodes and the cumulative duration of periods of high acidity are best combined to calculate the likelihood of the patient having pathological reflux.

Analysis of 24 hour records of oesophageal pH from healthy subjects and patients with symptomatic reflux with or without oesophagitis, reveals considerable individual variation in the time of day or night at which reflux occurs. Reflux has long been recognised to be particularly common in all groups in the post prandial period. There is good evidence that physiological reflux is virtually confined to the day. DeMeester and his colleagues described three patterns of oesophageal pH in patients with pathological reflux – reflux was found in the upright position only in 9%, in the recumbent position only in 37% and in both positions in 54%. The upright refluxers had much belching and postprandial reflux, but a low incidence of oesophagitis. Supine refluxers had more oesophagitis and showed impaired clearing of refluxed acid when in the supine position. Combined refluxers had the most severe oesophagitis and 15% had peptic strictures. They too showed impairment of oesophageal clearing when recumbent. Whether upright, supine and combined refluxers form separate groups of patients is uncertain, and it is more likely that they represent points on a spectrum of increasing reflux severity. Certainly patients may move from one category to another during progression of disease and increase in oesophagitis. The findings of the Edinburgh group in this issue refute the idea that patients with reflux can be categorised into DeMeester’s three types because acid exposure when recumbent was related to acid exposure when upright, although less in amount. Those with the mildest reflux showed it only in the upright position, implying that recumbent reflux only occurs in the presence of upright reflux, whereas upright reflux may occur alone, particularly when total acid exposure is low.

Every clinician is aware that nocturnal heartburn is often troublesome in the patient with gastro-oesophageal reflux and during sleep oesophageal clearing is impaired. Yet nocturnal acid exposure is considerably lower than that during the day. Nocturnal symptoms characteristically appear shortly after retiring and it seems likely that postprandial acidity from the evening meal, especially if this is taken late, is important. When oeso-
phageal clearing is grossly disrupted by motility disorder, such as in systemic sclerosis, nocturnal acid exposure is prolonged and persistent nocturnal pain is then common. Excepting such disorders, the Edinburgh group have produced strong evidence to show that nocturnal acid exposure does not play the cardinal role it was once assumed to have in causing oesophagitis.

Because 24 hour oesophageal pH monitoring is time consuming, relatively expensive, and inconvenient, a search has been made for shorter tests which would diagnose pathologcal degrees of reflux. Provocative tests have so far proved less reliable than long term monitoring, although one test in which weight lifting, straight leg raising, stooping and floor scrubbing are done before and after a standard meal, is proving of some value. The Edinburgh group found that postprandial acid exposure had a strong correlation with total 24 hour acid exposure and that this correlation was closer than that for recumbent or upright periods. This raises the possibility that a simple short pre- and postprandial recording of oesophageal pH might prove a useful test and indeed one group have already reported a 77% sensitivity and 96% specificity, compared with 24 hour monitoring.27

Oesophageal pH recording has been in use for 30 years and now is an appropriate time to take stock of its benefits. Most, but not all,28 would agree that oesophagitis and acid exposure have a direct relationship and this emphasises the pathogenetic importance of gastric acid in reflux oesophagitis. It follows that therapeautic endeavour must continue to be directed at suppression of acid and that oesophageal pH monitoring is an appropriate test to assess the likelihood of improvement from new treatments. Secondly, oesophageal pH monitoring has been valuable in establishing gastrooesophageal reflux as the cause of symptoms in the many patients in whom endoscopy fails to show an abnormality. In these subjects symptoms recorded by the patient with the event marker usually coincide with periods of oesophageal acidity and a good correlation has been reported between these and the results of the Bernstein acid perfusion test,29 which 24 hour pH monitoring is now beginning to supercede. Oesophageal pH monitoring is being increasingly applied to the problem of the patient with obscure chest pain and those with angina-like pain and normal coronary angiograms.30 It has been applied to the problem of nocturnal wheezing, where in one sense reflux was demonstrated in 50%.31 Control of reflux frequently alleviates respiratory symptoms. Oesophageal pH monitoring has proved valuable after anti reflux procedures such as fundoplication32 or the insertion of the Angelchik prosthesis.33 Many problems do remain unanswered and perhaps await the development of an equally reliable means of monitoring other oesophageal irritants, such as bile.

MICHAEL ATKINSON

Department of Surgery,
University of Nottingham,
University Hospital,
Nottingham

References

Monitoring oesophageal pH


30 DeMeester TR, O’Sullivan GC, Bermudez G, Midell AI, Cimochowski GE, Odrobinak J.


Monitoring oesophageal pH.

M Atkinson

Gut 1987 28: 509-514
doi: 10.1136/gut.28.5.509