maldistribution of both frequency of reflux episodes and number of prolonged reflux episodes. This suggests the probabilitiy of abnormalities in both peristalsis and DES function in these patients, and supports previous work from this institution.[18,19] We conclude that the failure of bolus emptying of acid is a more important contributor to the pathology of acid reflux than is a deficiency in salivary neutralization of acid.

RIS has been used to evaluate a series of symptomatic patients with GER by two groups. Tolin et al. found transit abnormalities in all 24 patients examined and isotope clearance was more abnormal when motor disorders were present on manometry.[7] None had endoscopic grading of esophagitis reported. Russell et al. studied 29 patients and detected transit abnormalities in 15 (52%).[20] Severe esophagitis or ulcer was present in 11 of 20 patients endoscoped, but the only abnormalities on manometry were nonspecific motor disorders of the esophagus in five of 28 (18%). After antireflux repair, the RIS abnormalities persisted despite improvement in symptoms. Neither group included ACT or 24-hour pH monitoring in their patient evaluation, and all patients were imaged in the supine position with an anterior view.

Our patients were selected from a large group undergoing extensive esophageal function evaluation for symptoms of GER and included only two of 24 with severe esophagitis on endoscopy. This may explain the lower incidence of abnormal RIS in our population. One beneficial sidelight of our investigation was that the RIS showed a high degree of correlation with results of 24-hour pH monitoring in patients with either normal or abnormal 24-hour pH monitoring. Because the performance of 24-hour pH monitoring is time-consuming, the RIS may prove to be a useful screening test in patients with symptoms of gastroesophageal reflux. As the radioisotope swallow has already been shown to be valuable in the detection of motor disorders of the esophagus, it may one day serve alongside endoscopy as the mainstay of confirmatory diagnosis of abnormal acid reflux in the evaluation of patients for possible antireflux surgery. It remains to be determined whether or not RIS will have a high degree of correlation with the presence or absence of esophagitis. Further investigation into this area is certainly warranted.

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Discussion

Dr. Robert E. Condon (Milwaukee, Wisconsin): I want to thank Drs. Skinner and Ferguson for providing me with an advance copy of their manuscript, and for their invitation to discuss their presentation. I think their work with this new measure of esophageal swallowing is going to prove to be an important advance in our understanding of the physiologic mechanisms that underlie the development of reflux esophagitis.

In patients who develop reflux esophagitis there is an interplay of two major factors, the frequency of reflux and the duration that the refluxed contents remain in the esophagus. The frequency of reflux is primarily reflected in manometric measurements of the tone and the length of the lower esophageal sphincter, and is also, obviously, importantly influenced by those factors that increase intra-abdominal pressure—body habitus, pregnancy, etc. We have had a reasonably good handle on those measures since Code first introduced esophageal manometry into clinical practice.

As we get onto the duration side of things, though, we have not had such a clear-cut handle on the two major components, which are the initial emptying of a bolus of refluxed contents and then the overall duration that it takes to neutralize acid in the esophagus. We now are beginning to develop those tools that will allow us to dissect these two important components of the duration side of the frequency/duration complex that is associated with reflux.

In that context, Drs. Skinner and Ferguson, I was a little surprised that you found such a great correlation between the radioisotope swallow results and the frequency of reflux. I had thought, at least to this moment, that frequency was primarily related to lower esophageal sphincter function and other factors, and not primarily to subsequent emptying of a reflux bolus of gastric content.

(Slide) While these physiologic tests add greatly to our understanding of the disease, what is their place in the clinical management of patients in the hands of surgeons such as ourselves? They obviously have a place in centers where investigation of esophageal function is carried out, but what about in other hospitals?

A few years ago we presented our experience with the surgical management of reflux esophagitis, an experience of several hundred patients, and were able to identify two sets of patients, one with typical, straightforward symptoms in whom the presence of reflux in the upright position on upper G.I. series and confirmatory endoscopy showing visible esophagitis was sufficient information on which to make a decision to operate, and, when operated, those patients had great symptomatic relief with fundoplication.

There was a smaller group of patients, another subset, who had rather more confusing and obscure symptoms, and it was in that group that we found physiologic testing was very helpful in sorting out the patients who would receive benefit from a surgical approach to control their disease, and those who perhaps might not, or might need another surgical approach to another surgical disorder.

At the time we presented our data, Dr. Skinner evinced a modest disagreement with our view that not all patients needed the full battery of these expensive tests. I would like to ask him if he still—I took it from one of the slides presented that he does—disagree with us. In that light, I would like to ask how much is this test going to cost patients in the future, and does Dr. Skinner really think that all of them are going to need it?

I want to thank the Association for the privilege of the floor, and I also want to thank my hosts, Willie and Bob Sparkman, and all the members of the Association and their ladies, for allowing Marcia and I to join with you in such a pleasant meeting.

DR. WALLACE P. RITCHIE (Philadelphia, Pennsylvania): I enjoyed this paper very much. It is a nice illustration of how we can use the talents of our radionuclide-user colleagues to do some important things diagnostically, not only in the esophagus, but in various other areas of the G.I. tract.

This radionuclide swallowing test that we have heard a little bit about today is extremely difficult. We have had some experience with it in Philadelphia. My question is: Are there not even broader uses for this particular approach? For example, do you have some experience with the test in the diagnosis of dysmotility disorders, achalasias, etc.? How does it correlate with standard manometry in this type of patient?

Finally, as a kind of confirmatory test that you are really doing something, what happens when you give patients with these dysmotility disorders (or normal patients without them) something like metoclopramide? Can you correlate the emptying that you see with the scan and what you would expect on the basis of the pharmacology of the drug?

DR. STEPHEN G. JOLLEY (Oklahoma City, Oklahoma): I have read, over the many years that Dr. Skinner has been writing about esophageal disorders, with great interest and, in particular, the studies that he has been doing recently in collaboration with Dr. Demeester.

As we have learned more and more about esophageal pH monitoring in patients with symptoms of gastroesophageal reflux, we find out that we are not only looking at the G. E. junction for abnormalities, but we are also looking at gastric emptying problems, esophageal motility problems, problems of the upper esophageal sphincter, and problems with acid neutralization by saliva.

The data were very interesting. However, I am not yet ready to accept that there is an impairment of neutralization of acid by saliva in these patients studied by Dr. Skinner. The radioisotope swallow was conducted with the patient swallowing water, and that is quite different, I would suspect, from swallowing, or having instilled into the esophagus, one-tenth normal hydrochloric acid.

I would propose to Dr. Skinner's group that perhaps these patients who have abnormal acid clearance times and normal radioisotope swallow may, in fact, have impaired acid sensitivity of the esophagus, as opposed to impaired acid neutralization by saliva.

DR. MARK K. FERGUSON (Closing discussion): I would like to thank the discussants for their insightful comments. The last one, in particular, hit the point in one area that we have not yet been able to cover. We do not know yet whether swallowing acids will produce significantly different results than swallowing neutral water, as we have done in these radioisotope swallows. Part of the difficulty with this is that combining the technetium/sulfur colloid with an acidic material tends to disperse the colloid, releasing free technetium throughout the body. This increases the background count significantly, and adversely influences the results of the test.

We do plan to obtain a slightly more expensive, more adherent bonding to the technetium and perform those tests in the future.

Dr. Ritchie is correct in pointing out that this sytem of testing is quite complex, and even after 4 years of working at it full time, Dr. Ryan is just beginning now to achieve some reproducability in the results. So far we have only been able to achieve it with water swallows, and since this is not as physiologic as swallowing something such as pudding or bread, we are still working on more refinements of this test. We have had some experience with radioisotope swallows in achalasia and acute spasm, as have other centers. It is particularly good for achalasia, and has been shown to correlate with improved results following myotomy for achalasia. It is not quite as good, but is of some value in detecting diffuse spasm. We do not have any experience with it yet using metoclopramide.

Dr. Condon's colleagues have contributed greatly over the last several years to our understanding of the acid clearance reflux and abnormality of the radioisotope swallow. It is more reasonable to expect a positive correlation between the abnormal number of prolonged reflux episodes and abnormalities on radioisotope swallow. I think, though, that the radioisotope swallow tends in general to correlate with nonspecific motor abnormalities of both the distal esophagus and the sphincter, and both of these have been shown to be independent components which can, in and of themselves, contribute to abnormal acid reflux.

As far as whether or not this test will be clinically useful in the future, with further investigation we may be able to suggest it as a valuable baseline test, because it does have a high degree of correlation with the 24-hour pH monitoring.

Regarding your question about the cost of this test, radioisotope swallow coupled with endoscopic evidence for esophagitis may eventually supplant the use of our other complex tests. It may also in the future bear some relationship to our choice of operation. If a patient has an abnormal radioisotope swallow, indicating the probability of emptying abnormalities of the distal esophagus, it could influence our deciding between the Belsey antireflux repair *versus* the Nissen antireflux repair. The latter, in our experience, is contraindicated in patients with distal motility abnormalities.