79

EVALUATION AND TREATMENT OF GASTROESOPHAGEAL REFLUX

DAVID B. SKINNER, Captain, USAF, MC*

THOMAS F. CAMP, JR., Major, USAF, MC

DONALD J. BOOTH, Captain, USAF, MC†

*Now at the Johns Hopkins University School of Medicine, Baltimore, Md.

†Assigned to the Surgical Service, Wilford Hall USAF Hospital, Lackland Air Force Base, Tex.

SAM-TR-68-50

FOREWORD

This report has been reviewed and is approved.

GEORGE E. SCHAFER
Colonel, USAF, MC
Commander

ABSTRACT

Although esophageal hiatal hernia and gastroesophageal reflux often occur together, they can occur separately. Reflux of digestive juice into the esophagus is the physiologic malfunction which causes symptoms and complications, whereas hiatal hernia is an anatomic abnormality which itself rarely causes symptoms or complications. A standardized measurement of reflux is valuable in many clinical situations.

Rational treatment for gastroesophageal reflux can be either medical or surgical. Moderate to marked esophageal reflux demands visual evaluation of the esophagus grade 2 or over is an indication for surgical management as the results of medical treatment are generally disappointing, and delay may do harm.

The basic surgical principles to restore the physiology of this region to normal seem to be: (1) placement of an adequate length of lower esophagus in an intra-abdominal position and firmly anchoring it; (2) creating a gastroesophageal flap valve by making an exaggerated angle; and (3) restoring close approximation of the diaphragm to the lower esophagus.

EVALUATION AND TREATMENT OF GASTROESOPHAGEAL REFLUX

I. INTRODUCTION

Hiatal hernia has recently become recognized as an extremely common condition, but widespread interest in its diagnosis and management has not led to general agreement concerning the pathophysiology and type of treatment required. The major obstacle has been the failure to discriminate between hiatal hernia and esophageal reflux. Although these conditions commonly occur together, each can occur without the other. Reflux is the physiologic malfunction and causes the common symptoms of postural regurgitation and heartburn, and the complications of aspiration, esophagitis, stricture, and bleeding. Hiatal hernia is an anatomic abnormality, and by itself causes only vague symptoms and the rare complications of acute obstruction or strangulation of the stomach.

Nowhere has the failure to discriminate between hiatal hernia and reflux been more clearly illustrated than in Air Force Manual 160-1, which describes the physical qualifications for military duty and flying. Grounds for disqualification from flying status are stated: "Hiatus hernia of any degree is disqualifying if symptomatic. Small asymptomatic hernia may be waived . . . . provided that altitude chamber flight 43,000 feet with an aviation medical officer as observer does not reveal respiratory or gastrointestinal symptoms." (AFM 160-1, par. 79d(5)). In paragraph 79a(4), chronic or recurrent esophagitis is listed as disqualifying.

These Air Force guidelines do not recognize the more significant abnormality of esophageal reflux which causes the esophagitis; they determine the likelihood of symptoms and illness to result from hiatal hernia alone. To present a more rational approach to this problem, the clinical findings in approximately 150 cases treated personally by operation and in a large series of cases treated at Frenchay Hospital in Bristol, England, under the supervision of Ronald Belsey, M.S., F.R.C.S., have been reviewed by one of us (25, 26). An attempt to understand the normal and abnormal function of the gastroesophageal junction by employing methods to study the cardia and reflux directly has been made in 175 patients. These personal experiences, clinical reviews, and physiologic studies form the basis for the approach to evaluation and management of hiatal hernia and gastroesophageal reflux currently employed at the USAF School of Aerospace Medicine and Wilford Hall USAF Hospital.

II. SUMMARY

Review of a large clinical experience and the applications of a test to measure gastroesophageal reflux directly have led to a suggested overall program for management of patients with hiatal hernia and gastroesophageal reflux. Most patients suffering from this affliction can be diagnosed accurately and given suitable and satisfactory treatment under the following conditions: by recognizing that gastroesophageal reflux rather than hiatal hernia is the significant problem; by employing esophagoscopy to detect esophagitis at an early stage regardless of symptoms in patients who reflux; by observing strict indications for surgical and medical treatment; by utilizing technical principles to prevent reflux in addition to reducing the hiatal hernia surgically; and by employing colon interposition when stricture and secondary shortening of the esophagus have resulted from delayed treatment, and other forms of therapy are not likely to succeed. Objective measurement of

esophageal reflux is the cornerstone of this program. Recognition of the central role of reflux in causing symptoms and complications which may occur with hiatal hernias should be included in a revision of Air Force standards for judging the significance of hiatal hernias.

III. DEFINITION OF TERMS

Hiatal hernia means the physical presence of a portion of stomach above the diaphragm demonstrated by radiography or by anatomic dissection. Esophageal reflux means the regurgitation of stomach contents into the esophagus. Esophagitis literally means inflammation of the esophagus which can be assessed only by direct inspection through esophagoscopy or by opening the esophagus. Esophagitis can be graded in severity from none to stricture formation. Two types of hiatal hernias are recognized which have an important clinical distinction. In the axial, or "sliding," or type I hiatal hernia, the gastroesophageal junction rises above the diaphragm; whereas as a type II, parahiatal, or "rolling" hernia, the gastroesophageal junction remains at the level of the hiatus and a portion of the stomach herniates into the thorax beside the esophagus. Patients with type I hiatal hernia generally have esophageal reflux, and those with type II hernia generally do not. The symptoms and signs associated with these two conditions differ accordingly. Other patients may have esophageal reflux without a demonstrable hernia (12). Such patients have an incompetent lower esophageal sphincter and suffer primarily from reflux as do those with a type I hiatal hernia. Frequently these patients do not seek treatment and the incidence of this condition is unknown.

IV. SYMPTOMS

Esophageal reflux associated with type I hiatal hernia or an incompetent cardia

Analysis of the symptoms caused by a sliding or type I hiatal hernia emphasizes that esophageal reflux is the most important factor in determining the complaints and complications. Typically the symptoms include two components: pain and regurgitation. The pain frequently radiates beneath the sternum and may be noted more to the right or left of the midline, but includes the subxiphoid region in its distribution. The nature of pain is a burning sensation, and is commonly called "heartburn" by the patient. Pain in the back between the scapulas may accompany esophageal reflux and frequently is as indication of esophagitis with a resulting mediastinal inflammatory reaction. The aggravation of pain by ingestion of alcohol or hot beverages also suggests esophagitis. Another characteristic symptom is regurgitation of gastric contents which may be described as a sour or bilious taste, or food "repeating." Frequent and effortless vomiting or regurgitation of a portion of nearly every meal occurs in more advanced cases.

The essential feature in the clinical diagnosis of symptomatic esophageal reflux is the relation of symptoms to postural change. Aggravation of pain and regurgitation by stooping or lying is diagnostic of esophageal reflux. Nocturnal discomfort relieved by sitting or standing is a frequent complaint. Occasionally, lying on one side in preference to the other will relieve symptoms. Frequently symptomatic patients sleep in the sitting position. Other common complaints are inability to lean forward—as to tie shoes or pick up objects from the floor. In patients whose symptoms are not aggravated by postural change, the symptoms must be regarded as atypical, and the diagnosis of reflux should be made with great caution. In patients with esophageal reflux documented by radiography and esophagoscopy, more than 75% had definite postural aggravation of typical symptoms (25). However, no correlation was observed between the severity and duration of symptoms and the presence or absence of esophagitis determined by esophagoscopy. Some who complained most bitterly of typical symptoms did not have visible esophagitis, whereas others who presented with peptic stricture had no specific symptoms suggesting reflux prior to the onset of dysphagia.

The complications of esophageal reflux are esophagitis, stricture, bleeding, and aspiration pneumonia which represent the major hazards

2

of the type I or sliding hernia. Severe esophagitis caused by reflux can damage the full thickness of the esophagus and create stricture. In such patients dysphagia is a universal complaint, so this symptom may denote a severe complication of reflux. However, patients with esophagitis but no stricture and even those without esophagitis may complain of dysphagia because of esophageal spasm. Of the patients with type I hiatal hernias or incompetent cardias, whose histories were reviewed, one-third complained of dysphagia, but this symptom was not associated with stricture in more than 40%. When dysphagia accompanies typical symptoms of reflux, the probable cause is readily suspected. However, dysphagia alone may be the presenting symptom of reflux as was the case in 8% of the patients reviewed. When dysphagia is the primary symptom, carcinoma of the esophagus and achalasia must be carefully ruled out. Esophageal reflux may lead to stricture and cause dysphagia before the patient is aware that anything is seriously wrong. The presence of typical symptoms of reflux, or increase in severity of the symptoms, will not necessarily present a warning of developing stricture. In fact, symptoms of pain and regurgitation may decrease as a stricture develops and prevents further reflux. In 20% of 226 patients seen because of stricture, dysphagia was the presenting complaint without preceding typical symptoms of esophageal reflux severe enough to require medical attention. For this reason the severity of symptoms is not an accurate guide to the necessity of treatment to prevent irreversible damage to the esophagus (25).

Aspiration of gastric contents into the lung is an important complication of reflux. This may be the major complaint in a small number of patients and was noted in 8% of the cases reviewed (25). In the large clinical experience reported by Urschel and Paulson (32) respiratory symptoms were reported by 61% of the patients. If a patient awakens coughing during the night, esophageal reflux should be considered, as regurgitated gastric contents may be easily inhaled during sleep in the recumbent position. Patients with unexplained lung abscess, chronic recurring pneumonitis, or bronchiectasis may also be the victims of chronic aspiration.

Major gastrointestinal hemorrhage is occasionally caused by esophagitis or esophageal ulcer occurring secondary to reflux (15). However, persistently positive tests for occult blood in the stool and anemia more commonly result from esophagitis. Massive bleeding when it occurs in patients with reflux is likely to arise from gastric or duodenal ulcers which will be found in approximately 10% of the patients with reflux.

A small number of patients will have unusual symptoms associated with esophageal reflux. A rare complaint will be the referral of all symptoms to the cervical esophagus and a fullness or foreign sensation in the throat. Pain may radiate to the base of the neck, both rami of the mandible, or to the ears. The diagnosis of globus hystericus may be considered, as radiographic study of the cervical esophagus and of the pharyngeal swallowing mechanism shows no abnormality. Such patients can be relieved by prevention of reflux if the correct diagnosis is made.

Another unusual syndrome is that of symptoms similar to angina pectoris caused by esophageal reflux. This presents a particularly difficult diagnostic problem which can occasionally be resolved if the symptoms are clearly related to meals and posture and are not evoked by exertion. Relief of symptoms by nitrites is not a reliable test, as esophageal spasm which may be responsible for the anginal-like symptoms will also be relieved by amyl nitrite or nitroglycerin. Since esophageal reflux and coronary insufficiency both occur frequently they may occur coincidentally, making it impossible to attribute all symptoms to one condition. Thirty-one patients with esophageal reflux and symptoms mimicking angina pectoris were treated surgically (25). In 16, the symptoms were clearly not related to effort and seemed caused by reflux exclusively. All had normal electrocardiograms, although 2 had undergone prolonged bed rest which had been unsuccessful in relieving the "cardiac" symptoms. All 16 were relieved of

3

their anginal symptoms and restored to normal activity following surgery. The other 15 patients were thought to have complications of reflux severe enough to warrant surgery in spite of true symptoms of coronary insufficiency. One had a previous myocardial infarction, and 4 others had electrocardiographic ST-segment depression or T-wave inversion. Two patients died of myocardial infarction during their hospitalization, and 3 others died of coronary heart disease during the next five years. In spite of the relief of esophageal reflux, only 3 had relief of their angina following operation.

Symptoms caused by type II or parahiatal hernia

The type II or parahiatal hernia is much less frequent than the type I hernia, occurring in a ratio of approximately 1 to 10 (26). Reflux is unusual in patients with type II hernia, and the symptoms are different from those of the type I hernia. The most common complaint is mild discomfort or fullness in the chest after meals, which can be relieved by belching or vomiting. Relationship of symptoms to posture is uncommon, and when it occurs, a combined type I and type II hernia is usually identified. Dysphagia is common, occurring in 20% of the patients reviewed, but is not associated with stricture or esophagitis. Extrinsic compression of the esophagus by the herniated stomach probably creates the difficulty in swallowing. Bleeding is a frequent and dangerous complication, as major hemorrhage requiring blood transfusion occurred in 18% of the patients reviewed (25). A common source of hemorrhage is an ulcer or gastritis in the supradiaphragmatic pouch. Patients may present with an asymptomatic, type II hernia causing a mass noted on chest x-ray. In spite of the absence of symptoms, the hazard of gastric infarction, obstruction, strangulation, or bleeding is always present and constitutes an indication for surgical treatment in such patients. Aspiration, esophagitis, and stricture are extremely uncommon in patients with type II or parahiatal hernia, once again emphasizing that these conditions are the result of esophageal reflux associated with the type I hernia and are not due to the anatomic presence of a hernia per se.

V. OBJECTIVE DIAGNOSIS OF ESOPHAGEAL REFLUX

When hiatal hernia or esophageal reflux is suspected on the basis of gastrointestinal symptoms, the diagnosis should be established by direct quantitation of the amount of reflux. In some patients the symptoms, including postural aggravation of both regurgitation and pain may be so classical that the diagnosis of reflux can be made with assurance without other studies. If the symptoms are at all equivocal, or atypical, further tests should be undertaken. Radiography has long been the standard means to diagnose abnormalities of the gastroesophageal junction, but emphasis has been placed on demonstration of the anatomic abnormality of a hiatal hernia rather than the more significant reflux. The incidence of hiatal hernia reported by radiologists in routine upper gastrointestinal examinations has varied widely suggesting that the frequency of the radiographic demonstration of a hernia may reflect more upon the skill, diligence, and zeal of the radiologist than upon the presence of a clinically significant defect. Reflux is reported much less frequently than herniation and, when demonstrated radiographically, is probably a significant abnormality. Many radiologists have favorite respiratory and postural maneuvers which they ask the patient to perform to increase the likelihood of reflux. Unfortunately, radiologists are frequently unable to demonstrate reflux in patients with typical symptoms including postural aggravation, so radiography has not provided sufficient diagnostic accuracy to be relied upon entirely in assessing the significance of a hiatal hernia or evaluating atypical symptoms. It should be emphasized that the radiographic demonstration of a hiatal hernia alone does not mean that the patient has esophageal reflux, or is in jeopardy of complications from this condition. For these reasons, a technic has been developed to measure gastroesophageal reflux directly in a standardized and semiquantitative fashion.

4

The technic currently used at the USAF School of Aerospace Medicine and Wilford Hall USAF Hospital is based upon modifications of earlier studies reported by Fyke et al. (9), Morgan et al. (21), and Tuttle and Grossman (31) with their coworkers and others, and was developed at the Massachusetts General Hospital by Kantrowitz et al. (16).

Two tubes are employed which are passed like a nasogastric tube into the stomach (fig. 1). One tube, composed of three polyvinyl catheters (I.D., 0.034 in.) bonded together with open-ended tips 5 cm. apart, transmits the pressures in the lumen of the esophagus or stomach through the fluid-filled catheters to a transducer and recorder. A long gastrointestinal pH electrode is used to record intraluminal pH. Routinely, the nasopharynx is sprayed with lidocaine before the tubes are inserted. The pressure monitoring tube is passed first into the stomach and then slowly withdrawn. Each fluid-filled catheter is flushed intermittently with water. Recent reports by Winans and Harris (33) and Pope (24) indicate that continuous infusion of the tubes with small quantities of fluid will increase the accuracy of pressure measurements. This modification will be incorporated in future studies. As the tubes are withdrawn at 0.5 cm. increments, the pressures at the tips 5 cm. apart can be compared. As the tips pass from stomach into the esophagus, a zone of pressure greater than gastric and esophageal pressures is identified (fig. 2). If gastric fundus pressure is defined as zero, the pressure, length, and location of this sphincter zone can be determined. A characteristic of the sphincter zone is that the pressure decreases slightly with swallowing, whereas intraesophageal pressures rise as the peristaltic wave passes, and intragastric pressure does not change. As the tip passes the site thought to represent the functional diaphragm, the pressure patterns change. Below the diaphragm, inspiration causes an increase in pressure,
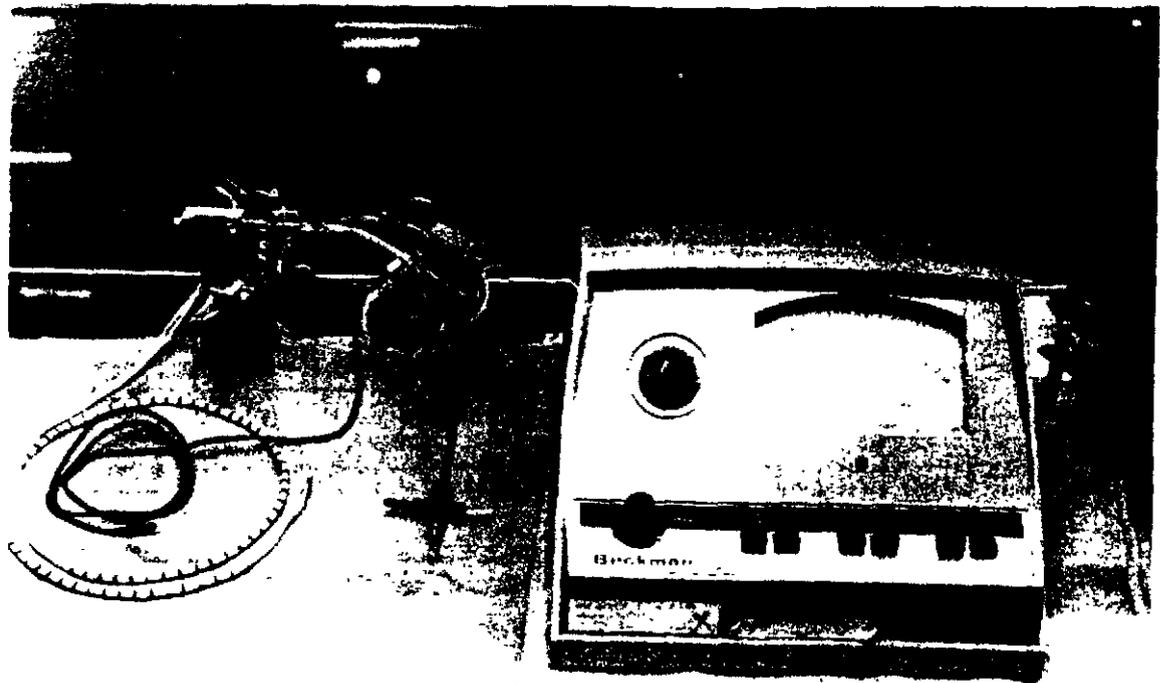

FIGURE 1

The light-colored triple lumen pressure tube with open tips 5 cm. apart and markings 1 cm. apart is connected to a pressure transducer. The black pH tube is marked in 1 cm. gradations and the reference electrode is between the tubes and the pH meter.

5

whereas above the diaphragm, pressure decreases during inspiration. The point of transition is called the pressure inversion point (PIP) and is commonly marked by a dampening or plateau in pressure. Normally this diaphragmatic barrier is straddled by the lower esophageal sphincter mechanism. Although Code and associates (5) have described abnormalities in the manometric characteristics of the gastroesophageal junction associated with hiatal hernia, we have been unable to confirm these observations in an experience which currently includes studies in approximately 175 individuals. Accordingly, the purpose of the manometric study is to locate the position of the lower esophageal sphincter and diaphragm in centimeters from the nostril and is not to diagnose a hiatal hernia specifically.

After locating the lower esophageal sphincter, the pH electrode is passed into the stomach and withdrawn at centimeter intervals after gastric pH is recorded. The pH electrode and meter are connected to the d.c. input of the recorder for continuous pH monitoring. Typically a functional barrier to acid is observed between the stomach and esophagus

which is marked by a sharp rise in pH as the tip of the electrode passes (fig. 3). Unfortunately, this pH gradient does not necessarily correspond to the exact level of the lower esophageal sphincter or diaphragm, so pH electrode withdrawal alone cannot be used to determine the location of gastroesophageal junction. Patients with reflux may have a very poor pH gradient, but others will have a sharp rise in pH, so that the pH withdrawal method alone is not an accurate guide to the competency of the cardia (fig. 3). Withdrawal of the pH electrode has been of no value in several patients encountered with achlorhydria and symptoms suggesting reflux. The pH values recorded during electrode withdrawal are used to supplement or confirm other phases of the study and are not considered important in themselves.

After withdrawal, the pH electrode is placed 5 cm. above the upper extent of the sphincter zone and the lead wire is taped to the nose to maintain the electrode in this position. The polyvinyl tubes are replaced into the stomach and a solution of 300 cc. of a microflocculation of barium sulfate (Barosperse), adjusted to a
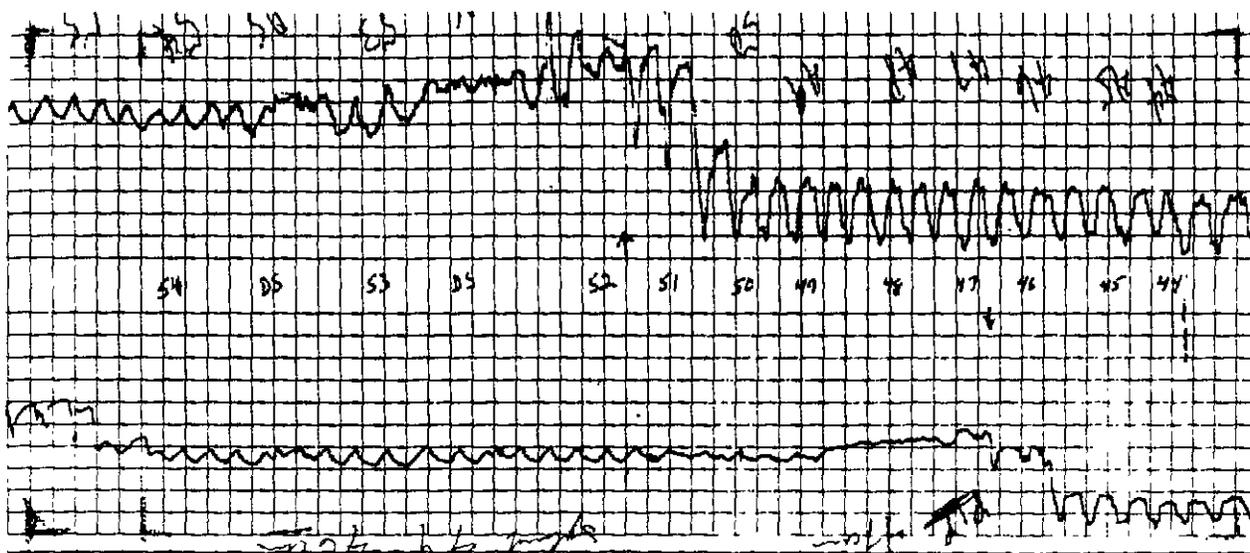

FIGURE 2

Intraluminal pressure tracings made by two catheters whose tips are 5 cm. apart demonstrate a high-pressure zone between 51 and 53 cm. from the nostril on the upper channels and between 49 and 46 cm. on the lower channels. The arrows at 52 and 47 cm. mark the point where the catheters demonstrate respiratory pressure reversal as they cross the diaphragm. (Illustration reproduced by courtesy of Aerospace Medicine)

pH of 1 by mixing with 6 N HCl, is introduced into the fasting stomach to provide a standard test solution. The polyvinyl tubes are flushed and withdrawn into the esophagus so the distal tip is 5 cm. above the lower esophageal sphincter. A fall in pH to less than 4 at the distance of 5 cm. above the lower esophageal sphincter is considered to be significant reflux. After the pH reading has been monitored while the patient is resting quietly in a supine position, the subject is instructed to perform two deep breaths, two Valsalva maneuvers, two Müller maneuvers (inspiration against the closed glottis), and two coughs. Respiratory efforts are repeated in the right- and left-side-down positions and in the head-down position by a 20° tilt from the horizontal. Reflux is detected by deflection in the pH tracing to 4.0 or lower. The test may be performed with television fluoroscopy available to check the location of the tubes and to verify massive reflux if this

appears on the pH tracing. By standardizing the volume and acidity in the stomach and the position and respiratory maneuvers of the patient during pH monitoring, the quantity of reflux can be graded semiquantitatively and compared from one patient to another.

In a survey of 48 asymptomatic normal volunteers between the ages of 18 and 25, no reflux was elicited in 60% and minimal reflux occurred in 40% (27). Minimal reflux is considered one or two isolated episodes of fall in the pH with rapid return to previous levels (fig. 4). Reflux greater than minimal was seen only once, and reflux occurred in the supine resting position in only one of the normal control subjects. Table I lists episodes in relation to body position. The number of episodes of reflux occurring during each type of respiratory maneuver is shown in table II. It is apparent that respiratory maneuvers
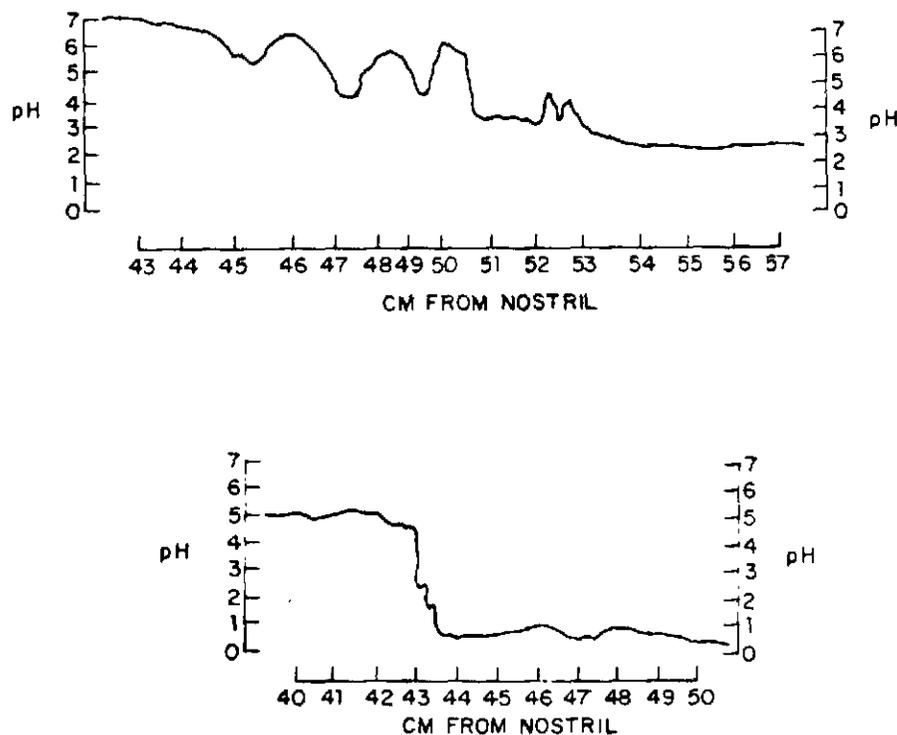

FIGURE 3

The upper tracing shows the gradual rise in pH which may occur in patients with reflux but occurs in some patients not demonstrating reflux. The lower picture showing the sharp rise in pH is most frequently seen in patients without reflux but does occur in some patients with gastroesophageal reflux.
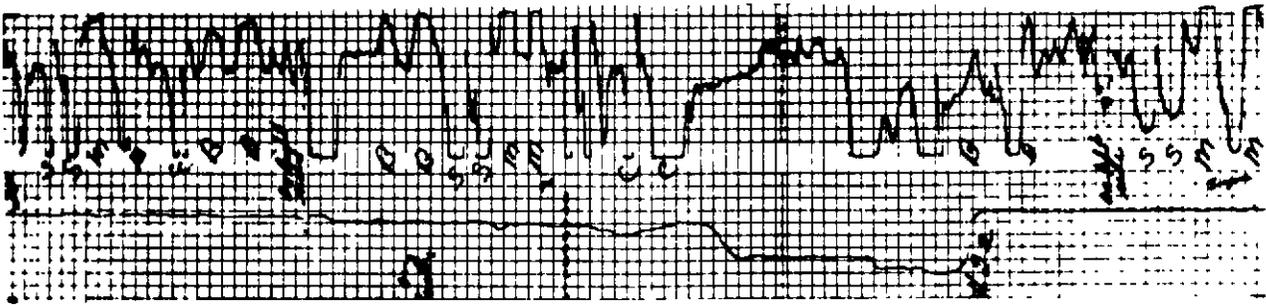
7

TABLE I

Body position in which each individual episode of reflux occurred in 48 normal volunteers

Supine	4
Right-side-down	30
Left-side-down	8
Head-down 20°	13

TABLE II

Respiratory maneuvers during which each individual episode of reflux occurred in 48 normal volunteers

Spontaneous	7
Deep breathing	10
Valsalva	7
Müller	15
Coughing	8
Turning	8

which increase gastroesophageal pressure gradients, such as the Müller maneuver or deep breathing, increase reflux; but body position such as the right-side-down attitude also increases reflux without increasing the gastroesophageal pressure gradient. Eight other individuals who were being evaluated for complaints not suggesting esophageal reflux were

studied. These individuals, ranging in age from 25 to 49 years, did not have hiatal hernia by upper gastrointestinal examination. No reflux was identified in 2, and minimal reflux was identified in 6.

It is apparent that minimal amounts of reflux may occur in individuals with normal gastroesophageal function, and indeed it is probable that reflux occurs occasionally in everyone. However, increased amounts of reflux which can be judged as moderate (three or more separate and prolonged drops in pH during performance of the standardized test with variable reflux by fluoroscopy), or marked reflux (multiple drops in pH or nearly continuous acidity in the esophagus and easily visible reflux fluoroscopically) does not occur in normal individuals; the presence of either represents abnormal gastroesophageal function. Moderate reflux is illustrated in figure 5.

At the Massachusetts General Hospital, at the School of Aerospace Medicine, and at Wilford Hall USAF Hospital, 164 patients having hiatal hernia with or without typical symptoms of gastroesophageal reflux have been studied. In all individuals with severe typical symptoms of reflux, and reflux seen by radiography, marked or moderate reflux has been demonstrated by this test. Thirteen patients with symptoms suggesting reflux without a radiographically demonstrated hiatal hernia have been shown to have moderate or marked reflux

8

by this test which established their diagnosis. On the other hand, 26 patients with asymptomatic hiatal hernia or with atypical symptoms not suggestive of reflux have shown, by this test, no reflux or only minimal reflux, thus discounting the clinical significance of the hiatal hernia or indicating that another source for symptoms should be sought.

Standardized measurements of reflux have proved to be valuable in the following clinical situations:

1. Demonstration of reflux in symptomatic patients with normal radiographic studies. Of 1,168 patients reviewed who had symptoms or complications of esophageal reflux or hiatal hernia severe enough to warrant surgical treatment, 14% had an incompetent cardia and reflux without a radiographically demonstrable hiatal hernia (25). In such patients, the objective measurement of reflux offers the most accurate way to make a diagnosis.

2. Assessment of atypical symptoms in patients having hiatal hernia. Nineteen patients having hiatal hernia demonstrated radiographically have been referred to the School of Aerospace Medicine for evaluation of chest pain, abdominal pain, or other complaints which might have been attributed to the hiatal

hernia. If reflux can be demonstrated objectively in such patients as it was in 6, the hiatal hernia may be considered as contributing to the patient's symptoms. If no reflux can be demonstrated, esophageal irritation and esophagitis can be discounted and the hiatal hernia is an unlikely source of symptoms. In such patients perfusion of the esophagus with 0.1 N HCl as described by Bernstein and Baker (3) has been useful in determining whether symptoms could be of esophageal origin.

3. Assessment of the significance of hiatal hernia when other abnormalities are detected. In patients having abdominal complaints, a hiatal hernia may be demonstrated in addition to ulcer or biliary disease. Objective measurement of presence and quantity of reflux can serve as a guide to the necessity of reconstructing the hiatus and cardia to assure complete relief of symptoms when cholecystectomy or surgical treatment for ulcer disease is undertaken. If no reflux is present, the hiatal hernia can be ignored in planning therapy as it is unlikely that symptoms will result from a small hernia in the absence of reflux.

4. Determination of the need for esophagoscopy in patients with hiatal hernia and slight symptoms. The severity of symptoms is not a safe guide to the likelihood of esophageal

FIGURE 5

Case 6261: During respiratory maneuvers or postural changes causing the esophageal pressure changes seen on the upper two channels, five episodes of reflux occurred as shown on the lower pH recording (grade 2 reflux). (Courtesy of Aerospace Medicine)

9

damage from reflux. Esophagitis can be detected accurately only by esophagoscopy, but esophagoscopy is a procedure which carries some risk. Accordingly, the objective demonstration of reflux is helpful in deciding whether esophagoscopy should be performed in a patient with hiatal hernia. If no reflux can be demonstrated, then esophagoscopy would not seem indicated, as the likelihood of esophagitis is quite small. On the other hand, if reflux is present, esophagoscopy should be performed, although symptoms may be mild, to exclude inflammation of the esophagus which may lead to stricture.

5. Assessment of the effectiveness of medical or surgical treatment of hiatal hernia and reflux. The "placebo" effects of any form of treatment are well recognized; so the relief of symptoms cannot be accepted as a guide to the success of surgical or medical treatment in treating esophageal reflux or hiatal hernia. Reflux may continue although a hiatal hernia may have been reduced anatomically. After older methods of hiatal hernia repair were used, the incidence of persisting reflux, which could cause further difficulties including esophagitis and stricture, was reported in approximately 25% of patients (26, 32). Accordingly, objective measurement of the control of reflux provides the only valid means to assess the success of treatment. If medical treatment for symptomatic reflux is undertaken, subsequent performance of a reflux test should be used as a guide to the success of therapy or the need for further treatment and evaluation of the patient. In some individuals medical treatment, including weight loss, will restore competency to the cardia and convert an abnormal reflux test to normal (28). Other patients will continue to reflux in spite of relief of symptoms, and must undergo further treatment to prevent esophagitis and later stricture formation.

6. Investigation of the effects of pharmacologic or environmental stress on the cardia and identification of factors influencing normal and abnormal gastroesophageal function.

Examples of the measurement of reflux for experimental purposes are:

1. Forty-eight normal volunteer subjects underwent esophageal reflux testing before and after intravenous administration of 1 mg. of atropine sulfate. The drug caused a significant reduction in the lower esophageal sphincter pressure and length. In spite of this, no increase in reflux was detected in the normal volunteers (27). This indicated that measurement of lower esophageal sphincter pressure alone by uninfused open-tipped tubes was not a reliable guide to assess competency of the cardia. In three patients with symptomatic hiatal hernias, administration of atropine resulted in an increased degree of reflux, suggesting that anticholinergic drugs should be used cautiously, if at all, in the treatment of hiatal hernia and incompetent cardia (16). Study of the effects of vagotomy and gastric operations on the incidence of reflux is in progress at Wilford Hall USAF Hospital. Preliminary observations in 4 patients at the Massachusetts General Hospital suggested that vagotomy and gastrectomy or pyloroplasty was associated with an increased incidence of reflux postoperatively (16). If this finding is substantiated, reconstruction of the hiatus may be performed at the time of vagotomy.

2. Esophageal reflux tests were performed in 5 monkeys. Subsequently the studies were repeated in the monkeys under conditions of -2 or -3 G_z, using the USAFSAM human centrifuge. Reflux was increased in 2 animals who had minimal reflux under resting conditions. Three monkeys which had no reflux demonstrated prior to centrifugation maintained competency of the cardia in spite of the increased foot-to-head gravitational stress. These results suggest that reflux may increase in fliers under conditions of gravitational stress, whereas normal individuals should be able to maintain competency of the cardia in spite of negative G_z stress. One aviator, evaluated at the School of Aerospace Medicine, complained of regurgitation and vomiting in his aircraft only when his plane was placed in a particular attitude under increased gravity. During the test, reflux occurred only when the individual assumed a body attitude similar to that in which he experienced his complaints in the aircraft.

10

3. Inability of the esophagus to clear itself of 15 cc. of instilled 0.1 N HCl has been observed in patients with symptomatic hiatal hernias and abnormal reflux tests. Surgical correction of hiatal hernia resulting in normal reflux tests also restored normal or improved acid clearing in 6 patients (4). The duration of contact between regurgitated material and esophageal mucosa is probably related to the development of esophagitis; so these observations lend further importance to the objective measurement of reflux. Measurement of acid clearing from the esophagus can be easily added to the standardized test for esophageal reflux, and prolonged clearing of acid from the esophagus adds significance to the results of the reflux test.

VI. ESOPHAGOSCOPY

Standardized measurement of esophageal reflux makes it possible to identify, among patients with hiatal hernias or other symptoms, those who have abnormal reflux. Such patients are in jeopardy of the complications of esophagitis, bleeding, stricture, and aspiration. Treatment of hiatal hernia or reflux is aimed at the prevention of such complications. The presence of esophagitis makes treatment mandatory and increases the likelihood that surgery will be required. Accordingly, esophagoscopy plays a major role in selecting those patients who are developing esophagitis. To assess the competency of the cardia directly, esophagoscopy may be routinely performed under local anesthesia with the patients sitting upright in a dental chair (26). This body position helps to keep the esophagus empty of refluxed material during examination and reduces the chance of aspiration. The competency of the cardia can be observed directly and the presence of reflux verified. The degree and extent of esophagitis can be graded on a scale of 1 to 4. Grade 1 esophagitis indicates only mucosal reddening. Grade 2 esophagitis is noted when superficial ulcers and a white adherent inflammatory exudate or membrane are observed. In grade 3 esophagitis, there is an element of thickening and stiffening of the wall of the esophagus due to more advanced inflammation. Grade 4 esophagitis is recorded when a definite stricture is already present. If grade 2 esophagitis or greater is observed, surgery is generally advised as the results of medical treatment are disappointing. When ulcer formation has already occurred, surgical treatment may be a matter of urgency since ulceration is the precursor of permanent damage to the esophagus. Progress from grade 2 esophagitis to stricture may occur with remarkable rapidity, particularly in children.

VII. MEDICAL TREATMENT

If esophagoscopy does not reveal ulceration, symptoms are treated medically. The medical program should include attempts to reduce reflux by gravity. The patient is instructed to sleep with 6-inch blocks under the head of his bed and to remain in the upright position after meals. Small meals are advised to prevent overdistention of the stomach, and antacids should be taken at bedtime and at intervals between meals to reduce gastric acidity. Since many patients with reflux are overweight, weight reduction is an important part of treatment; it alone may result in decreased regurgitation and symptoms. Documentation of decreased reflux has been obtained in patients who have followed a medical program and weight loss program rigidly (28). If a prolonged and thorough trial of medical treatment fails to control disabling symptoms, surgical treatment may be undertaken for the relief of symptoms alone even though esophagitis is not present.

VIII. INDICATIONS FOR SURGERY

Based on an evaluation of the amount of reflux, the patient's symptoms and response to medical therapy, and the findings of esophagoscopy, three major indications for surgical treatment are recognized: (1) reflux esophagitis of grade 2 or greater severity or stricture formation; (2) pulmonary symptoms attributable to recurring aspiration; and (3) severity of symptoms if these are disabling and cannot be managed medically.

Type II or parahiatal hernia should be treated surgically regardless of symptoms as

it may result in the sudden and disastrous complications of bleeding, obstruction, perforation, or strangulation. Belsey described 21 asymptomatic patients with type II hernia, who were treated by observation alone. Six died directly from major complications of the hernia. The other 15 were then repaired (26).

IX. SURGICAL TREATMENT

Once the indications for surgery exist, the planned operative repair should be designed to prevent esophageal reflux in addition to reducing the hiatal hernia. Principles regarded as important in restoring integrity to the gastroesophageal junction include maintaining the lower esophageal sphincter (9), restoring the sphincter region to the increased pressure intra-abdominal environment by creating an exaggerated abdominal length of esophagus (26), creating a gastroesophageal flap valve by making an exaggerated angle (6), preserving vagal integrity (34), and restoring close approximation of the diaphragm to the lower esophagus (1). Several types of hiatal hernia repair and reconstruction of the cardia, done either through the thorax or abdomen, are designed to recognize these factors. The significance and importance of the phreno-esophageal ligament remain controversial. Some investigators feel that weakness of these ligaments is a defect leading to increased reflux (19), whereas Dillard and Anderson (8) suggest that the ligaments may tend to pull the gastroesophageal junction open in patients with hiatal hernia and advocate division of the ligaments. If the aforementioned principles are recognized, experience with a large number of patients in whom the phrenoesophageal attachments have been completely divided indicates that this tissue is not necessary for satisfactory hiatal hernia repair and prevention of reflux (26).

When the indications for hiatal hernia repair are clear, and symptoms are marked or complications seriously endanger health, a repair should be selected which will give the most likely chance for success in the hands of the operating surgeon. Transthoracic repair of the hernia may be preferred in patients with advanced esophagitis, as dissection and mobilization of the esophagus is facilitated through this approach. If esophagitis is mild or absent, and a concomitant intra-abdominal disease such as cholecystitis or peptic ulcer is present, a repair employing the same principles may be performed from below the diaphragm. The Belsey Mark IV operation performed through a thoracotomy has yielded excellent results by complete mobilization of the gastroesophageal junction, suturing of a cuff of stomach around the lower esophagus, restoring the reconstructed gastroesophageal angle beneath the diaphragm by a series of sutures passed through the diaphragm, stomach, and esophagus, and finally narrowing the hiatus around the lower esophagus (26). Good control of reflux has also been achieved by the technic advocated by Hill (14) in which the gastroesophageal junction is completely mobilized from an abdominal approach. The gastroesophageal junction is sutured through the origins of the diaphragm posteriorly at a level well below the hiatus, the hiatus is narrowed posteriorly around the esophagus, and the fundus of the stomach can be tacked against the intra-abdominal segment of esophagus to create an exaggerated angle. Other methods such as the fundoplication advocated by Nissen and Rossetti (22), the repair described by Collis et al. (6), which is similar to that of Hill except that the diaphragm is closed anteriorly, and the technic developed by Husfeldt (17), all employ the same principles and can be expected to provide adequate control of reflux in addition to reducing the hernia. Older operations—such as those advocated by Sweet (29), Harrington (10), and Allison (1)—were designed primarily to reduce the hernia anatomically without creating an exaggerated intra-abdominal segment of esophagus and gastroesophageal angle to prevent reflux. These repairs were associated with a distressingly high incidence of recurrent reflux even though the hernia may have been reduced successfully, and are no longer advocated (26, 32).

Discouragement with the results of older methods of hiatal hernia repair led a number of surgeons to advocate acid-reducing operations such as vagotomy and gastrectomy or pyloroplasty in the treatment of hiatal

hernia (11, 20, 23). As reflux can be controlled satisfactorily when reconstruction of the cardia is added to reduction of the hiatal hernia, these gastric operations do not appear warranted unless peptic ulcer disease is present. If the gastric contents cannot regurgitate into the esophagus, the amount of acidity in the stomach would appear to have no bearing on the results of surgical reconstruction of the cardia. It does not appear warranted to accept the incidence of complications such as dumping, suture line leaks, and weight loss which may be added by incorporating vagotomy and gastric resection or drainage procedure with a simple hiatal hernia repair and cardial reconstruction.

X. RESULTS OF SURGERY

In presenting the results of surgery for hiatal hernia or other benign conditions, the same type of followup and analysis of results should be used as is done for the surgery of malignant diseases. Considering operative mortality of 1.2%, symptomatic or asymptomatic recurrences in 7%, poor symptomatic results without recurrence demonstrable by x-ray or esophagoscopy in 4%, and patients lost to followup (3%), then the Mark IV repair of Belsey was demonstrated to be successful clinically and anatomically in 85% of the 632 cases reported by Skinner and Belsey (26). The followup period was more than three years in 75% of the patients. The overall recurrence rate in patients followed more than three years was 8.6%. More recently, patients undergoing this operation have been studied routinely before and after surgery by the esophageal reflux test, and adequate control of reflux has been routinely demonstrated following this operation. This experience places the results of hiatal hernia repair at the level of success expected for the surgical treatment of duodenal ulcer disease. The recurrence rates for other types of surgical procedures incorporating the same principles as the Belsey Mark IV repair— including the technics advocated by Hill, Collis, Husfeldt, and Nisson— are in the same general range of less than 10%. A particularly encouraging recent report was that by Hill (14), who described hiatal hernia repairs in 149 patients with no symptomatic or radiographic recurrences to date with an average followup period of eight years. Hill's patients have been thoroughly studied by esophageal pH monitoring tests in a manner similar to that described.

Surgery offers a good prospect for successful control of esophageal reflux when specific indications for treatment are recognized. Failure to offer surgical treatment at a time when esophagitis has been recognized, will lead to an increased likelihood of peptic stricture. When secondary shortening of the esophagus due to fibrosis and stricture has occurred, the recurrence rate from attempted simple repair of hiatal hernia will be unacceptable. Esophagoscopy and dilatation are frequently unsatisfactory to the patient and physician, and more radical surgical operations may be necessary— such as resection of the esophagus with interposition of an intestinal segment (2) or a plastic operation to create a gastric tube to lengthen the short esophagus (13, 18). These operations carry a higher mortality rate, although long-term control of reflux achieved by colon interposition has been achieved in 92% of 59 patients treated in this fashion (26).

REFERENCES

1. Allison, P. R. Reflux esophagitis, sliding hiatus hernia, and the anatomy of repair. Surg. Gynec. Obstet. 92:419 (1951).

2. Belsey, R. Reconstruction of the esophagus with left colon. J. Thorac. Cardiov. Surg. 49:33-55 (1965).

3. Bernstein, L. M., and L. A. Baker. A clinical test for esophagitis. Gastroenterology 34:760-781 (1958).

4. Booth, D. J., W. T. Kemmerer, and D. B. Skinner. Acid clearing from the distal esophagus. Arch. Surg. (Accepted for publication)

5. Code, C. F., M. L. Kelley, J. F. Schlegel, and A. M. Olsen. Detection of hiatal hernia during esophageal motility tests. Gastroenterology 43:521 (1962).

6. Collis, J. L., T. E. Kelly, and A. M. Wiley. Anatomy of the crura of the diaphragm and the surgery of the hiatus hernia. Thorax 9:175 (1954).

7. Collis, J. L. Gastroplasty. Thoraxchirurgie 11:57-64 (1963).

8. Dillard, D. H., and H. N. Anderson. A new concept for the mechanism of sphincteric failure in sliding esophageal hiatal hernia. Surg. Gynec. Obstet. 122:1030-1038 (1966).

9. Fyke, F. E., Jr., C. F. Code, and J. F. Schlegel. The gastroesophageal sphincter in healthy human beings. Gastroenterologia (Basel) 86:135 (1956).

10. Harrington, S. W. Esophageal hiatal diaphragmatic hernia. Surg. Gynec. Obstet. 100:277 (1955).

11. Herrington, J. L., Jr. Hiatal hernia with esophagitis (treatment by hernia repair, vagotomy, and pyloroplasty or antrectomy). Ann. Surg. 151:812 (1960).

12. Hiebert, C. A., and R. H. R. Belsey. Incompetency of the gastric cardia without radiologic evidence of hiatal hernia. J. Thorac. Cardiov. Surg. 42:352 (1961).

13. Heimlich, J. H. Peptic esophagitis with stricture treated by reconstruction of the esophagus with a reversed gastric tube. Surg. Gynec. Obstet. 114:673-676 (1962).

14. Hill, L. D. An effective operation for hiatal hernia: An 8-year appraisal. Ann. Surg. 166: 681-692 (1967).

15. Hood, R. H., Jr., and J. A. McChesney. Hiatus hernia with esophagitis and acute hemorrhage. J.A.M.A. 182:243-246 (1962).

16. Kantrowitz, P. A., J. G. Corson, and D. B. Skinner. Standardized measurement of gastroesophageal reflux. (To be published)

17. Malm, A. Hiatushernien: Operative Behandlung und Spaetresultate. Thoraxchirurgie 11:66-69 (1963).

18. Merendino, K. A., and D. H. Dillard. The concepts of sphincter substitution by an interposed jejunal segment for anatomic and physiologic abnormalities at the esophagogastric junction. Ann. Surg. 142:486 (1955).

19. Michelson, E., and C. I. Siegel. The role of the phrenico-esophageal ligament in the lower esophageal sphincter. Surg. Gynec. Obstet. 118:1291-1294 (1964).

20. Miller, F. A., H. Neto, and R. Sellers. Esophagitis associated with esophageal hiatal hernia. J.A.M.A. 183:1008-1010 (1963).

21. Morgan, E. H., L. D. Hill, and D. K. Selby. Objective assessment of gastroesophageal reflux secondary to hiatal hernia. Dis. Chest 43:367-376 (1963).

22. Nissen, R., and M. Rossetti. Surgery of hiatal and other diaphragmatic hernias. J. Int. Coll. Surg. 43:663-674 (1965).

23. Payne, W. F., H. A. Andersen, and F. H. Ellis, Jr. Treatment of short esophagus with esophagitis by gastric drainage procedures with and without vagotomy. Surg. Gynec. Obstet. 116:523-528 (1963).

24. Pope, C. E., II. A dynamic test of sphincter strength: Its application to the lower esophageal sphincter. Gastroenterology 52:779-786 (1967).

25. Skinner, D. B. Symptomatic esophageal reflux. Amer. J. Dig. Dis. 11:771-779 (1966).

26. Skinner, D. B., and R. H. H. Belsey. Surgical management of esophageal reflux and hiatus hernia. J. Thorac. Cardiov. Surg. 53:33-54 (1967).

27. Skinner, D. B., and T. F. Camp, Jr. Relation of esophageal reflux to lower esophageal sphincter pressure decreased by atropine. Gastroenterology. (Accepted for publication)

28. Skinner, D. B., and T. F. Camp, Jr. Measurement of gastroesophageal reflux in the evaluation of hiatus hernia and chest pain in fliers. Aerospace Med. 38:846-850 (1967).

29. Sweet, R. H. Esophageal hiatus hernia of the diaphragm: A statistical survey. J. Thorac. Cardiov. Surg. 44:145-152 (1962).

30. Sweet, R. H. Esophageal hiatus hernia of the diaphragm: The anatomical characteristics, technics of repair, and results of treatment in 111 consecutive cases. Ann. Surg. 135:1 (1952).

31. Tuttle, S. G., and M. I. Grossman. Detection of gastroesophageal reflux by simultaneous measurement of intraluminal pressure and pH. Proc. Soc. Exp. Biol. Med. 98:225-227 (1958).

32. Urschel, H. C., Jr., and D. L. Paulson. Gastro-esophageal reflux and hiatal hernia, complications and therapy. J. Thorac. Cardiov. Surg. Surg. 53:21-36 (1967).

33. Winans, C. S., and L. D. Harris. Quantitation of lower esophageal sphincter competence. Gastroenterology 52:773-778 (1967).

34. Woodward, D. A. K., J. A. Williams, and M. Atkinson. Reported in the 27th Annual Meeting of the British Society of Gastroenterology. Gastroenterology 52:619 (1967).

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1 ORIGINATING ACTIVITY *(Corporate author)*	2a. REPORT SECURITY CLASSIFICATION
USAF School of Aerospace Medicine	Unclassified
Aerospace Medical Division (AFSC)	2b. GROUP
Brooks Air Force Base, Texas	

3 REPORT TITLE

EVALUATION AND TREATMENT OF GASTROESOPHAGEAL REFLUX

4 DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

July 1965 - Jan. 1967

5 AUTHOR(S) *(First name, middle initial, last name)*

David B. Skinner, Captain, USAF, MC
Thomas F. Camp, Jr., Major, USAF, MC
Donald J. Booth, Captain, USAF, MC

6 REPORT DATE	7a. TOTAL NO OF PAGES	7b. NO OF REFS
June 1968	15	34

8a CONTRACT OR GRANT NO	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO 7755	SAM-TR-68-50
c Task No. 775507	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d	

10 DISTRIBUTION STATEMENT

This document has been approved for public release and sale; its distribution
is unlimited.

11 SUPPLEMENTARY NOTES	12 SPONSORING MILITARY ACTIVITY
	USAF School of Aerospace Medicine
	Aerospace Medical Division (AFSC)
	Brooks Air Force Base, Texas

13 ABSTRACT

Although esophageal hiatal hernia and gastroesophageal reflux often occur to-
gether, they can occur separately. Reflux of digestive juice into the esophagus is
the physiologic malfunction which causes symptoms and complications, whereas hiatal
hernia is an anatomic abnormality which itself rarely causes symptoms or complica-
tions. A standardized measurement of reflux is valuable in many clinical situations.

Rational treatment for gastroesophageal reflux can be either medical or surgical.
Moderate to marked esophageal reflux demands visual evaluation of the esophagus by
esophagoscopy to determine the degree and extent of esophagitis. Esophagitis of
grade 2 or over is an indication for surgical management as the results of medical
treatment are generally disappointing, and delay may do harm.

The basic surgical principles to restore the physiology of this region to nor-
mal seem to be: (1) placement of an adequate length of lower esophagus in an intra-
abdominal position and firmly anchoring it; (2) creating a gastroesophageal flap
valve by making an exaggerated angle; and (3) restoring close approximation of the
diaphragm to the lower esophagus.

DD FORM 1473
1 NOV 65

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Gastroesophageal reflux Hiatal hernia Heartburn Esophagitis Esophagoscopy Esophageal motility						