The medical problem that defies diagnosis may be extremely distressing. There is scant satisfaction to the physician or the patient who suffers from chest pain, in a conclusion reached after extensive study, that no definite diagnosis can be made even though several diseases can be ruled out. This leaves an uncomfortable emptiness since all physicians know, and increasing numbers of patients are realizing, that coronary artery disease cannot be absolutely ruled out by the absence of positive findings. Therefore, chest pain of undetermined origin is an unsatisfactory diagnosis to make or to receive and is best avoided whenever possible.

There are many causes for chest pain besides disease of the coronary arteries.

They include inflammatory, neoplastic, degenerative or traumatic diseases of the lungs, pleura, pericardium, lymphatics and chest wall; neurologic disorders of the peripheral nerves or spinal cord; functional problems; disease of the great vessels; and esophageal diseases, such as esophagitis, diaphragmatic hernia, diverticula, stenosis, rupture, or malignancy. Usually these can be diagnosed positively and quite clearly differentiated from coronary artery disease. We have found it possible, by measuring and studying esophageal motility patterns recorded by the direct-pressure-measuring method, to make a positive diagnosis of diffuse spasm of the esophagus in several patients with unexplained chest pain. This spasm would appear to be a logical cause for the chest pain and response to therapy directed at the esophageal spasm tends to support this contention.

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**FIGURE 1:** This normal esophageal motility record shows a smooth progression of the contraction wave down the esophagus initiated by the act of swallowing. (S) Pressure waves are recorded through water-filled catheters at various distances from the incisors, as indicated, picked up by Statham strain gauges, and recorded on a photokymographic recorder.
The following are illustrative cases:

**Case 1**

This 50-year-old white man was admitted on April 24, 1961, because of sudden, severe crushing precordial pain radiating into the left shoulder and down the left arm, associated with weakness and perspiration. His pain persisted until relieved by meperidine (Demerol) in the hospital about 45 minutes after its onset. He had a past record of hypertensive vascular disease and recurrent eructation with retrosternal burning.

Physical examination revealed a pulse of 70, blood pressure 150/100, early A-V nicking of the arterioles of the ocular fundus, but no specific physical abnormality.

Though the electrocardiogram was entirely normal, he was nonetheless placed on therapy for a myocardial infarction, including bed rest, oxygen, anticoagulants, and narcotics as necessary for pain. Serial electrocardiograms and SGO-T were entirely normal without significant change. He developed no fever or leukocytosis. After three days of observation, he was discharged to his home for a short period of further convalescence. Thereafter, further studies were pursued. Gallbladder x-ray findings were normal. Stomach x-ray series was normal with no evidence of diaphragmatic hernia. Esophageal motility studies showed pronounced diffuse spasm (Fig 2).

He was placed on treatment with an antacid (Kolantyl) with considerable improvement in his recurrent retrosternal burning and no recurrence of his severe chest pain.

**Figure 2** (Case 1): The motility tracing shows severe contractions of the esophagus with some delay in propagation of the contraction wave.

**Case 2**

This 58-year-old white woman was seen in the Scott and White Clinic because of a four-year history of recurrent aching pain and numbness in both arms, occasionally associated with nausea and vomiting, not consistently associated with exertion, and not relieved by nitroglycerin.

When these symptoms first became persistently recurrent, she underwent extensive medical evaluation at another clinic. The only finding of any apparent significance was a cholesterol of 300 mg. per cent. A presumptive diagnosis of coronary artery disease was made, and she was placed on a low-fat diet with corn oil, triparanol (MER-29), and coronary dilators with no benefit whatsoever.

Physical examination revealed no significant abnormality. Blood cholesterol was 354 mg. per cent. Basic laboratory findings were normal. BMR, stomach x-ray, electrocardiogram, cardiac fluoroscopy and gallbladder x-ray were normal. Esophageal motility studies showed striking diffuse spasm.

She was placed on appropriate treatment with a good symptomatic response.

**Case 3**

This 50-year-old white man was referred to Scott and White Clinic for evaluation of recurrent substernal distress. He gave a history of chronic indigestion and "acid stomach" for at least 12 years without definite duodenal ulcer being found on several x-ray examinations. In 1958, he had a rather severe episode of substernal pain for which he was hospitalized for several days as a possible myocardial infarction. Repeated electrocardiograms were normal, and he was discharged without definite diagnosis.

His referral at this time was prompted by two closely recurring episodes of sudden, severe, low, substernal and epigastric pain associated with nausea and dyspnea which required Demerol for relief.

Findings on physical examination and electrocardiogram were normal. Double Master’s test was negative. Cardiac fluoroscopy and stomach x-ray findings were normal, with no evidence of diaphragmatic hernia. Esophageal motility studies showed diffuse spasm (Fig 3). He was placed on appropriate treatment for esophageal spasm with good response on limited follow-up.

**Case 4**

This 64-year-old white woman was seen for evaluation of left lower chest pain. She first developed symptoms when, after eating Thanksgiving dinner in 1960, she experienced severe pain and tightness in the left lower anterior chest and across the precordium radiating up into the neck and down the left arm, somewhat exaggerated by deep breathing. She was rushed to the hospital by ambulance. En route, she
vomited and was relieved of symptoms. Studies at that time, including electrocardiograms, gallbladder x-ray films, stomach and colon x-ray examinations failed to establish a diagnosis, and a presumptive diagnosis of “virus infection” was made. Thereafter, she was aware of recurrent burning in the throat and in the retrosternal area of a mild degree. In mid-December, 1960, she had a severe episode of chest pain associated with syncope for which she was hospitalized for five days for possible myocardial infarction without a positive diagnosis being made. She gave a past history of clinically diagnosed duodenal ulcer.

On her initial physical examination, no significant abnormality was noted. Two days later, she was brought to the emergency room with a history of having taken the evening pills for a gallbladder x-ray examination the following morning and being awakened at 2 a.m. with severe, oppressive, epigastric and precordial pain radiating down the left arm, associated with belching. She had no benefit from nitroglycerin. An electrocardiogram taken during pain, stomach x-ray findings and serum amylase were normal. Gallbladder x-ray examination showed cholelithiasis. Esophageal motility studies revealed severe diffuse spasm.

Since it was felt that the esophageal spasm may have been related to the gastrointestinal dysfunction due to the gallbladder disease, a cholecystectomy was performed.

**CASE 5**

This 53-year-old white woman was referred to this Clinic on April 19, 1961 for cardiac evaluation because of recurrent left chest pain. Six months previously, she had first experienced lower anterior left chest pain of only a moderate degree occasionally radiating into the left arm with numbness of the left arm, aggravated by movement of the arms and shoulders. It was recurrent and not related to physical exertion. She was given nitroglycerin by her physician which she believed helped her pain somewhat. She also complained of occasional episodes of severe epigastric pain which appeared to be different from the chest pain.

Physical examination revealed no significant abnormality. Electrocardiogram, gallbladder x-ray examination, cervical spine x-ray findings, and results of basic laboratory studies were normal. Esophageal motility studies showed marked diffuse spasm (Fig. 4).

She experienced marked improvement on specific treatment.

**CASE 6**

This 49-year-old welder was seen for evaluation of chest pain. In 1957, a diagnosis of symptomatic diaphragmatic hernia was made on x-ray examination with symptoms of recurrent severe squeezing precordial pain, not related to exertion, frequently occurring with recumbency, often associated with belching and sour eructation. This hernia was repaired surgically. Within a year, all symptoms recurred, and he was seen by several different physicians. He had stomach x-ray studies, several electrocardiograms and Master’s tests, all of which were reported as normal.

Physical examination was essentially normal. Electrocardiogram was normal. Double Master’s test was negative. Stomach x-ray findings were normal with no evidence of diaphragmatic hernia.
Gallbladder x-ray examination was normal. Esophageal motility studies showed spasm of the lower one-third of the esophagus which was felt to be the basis for his symptomatology.

He was greatly improved symptomatically by treatment for the esophageal spasm.

**Case 7**

This 64-year-old white man was seen on April 14, 1960 with chief complaint of difficult swallowing. Twenty-five years prior, he had fractured several ribs and reported that thereafter he had recurrent trouble with swallowed food apparently "hanging up" part way down with retrosternal pain sometimes only relieved by vomiting. A diagnosis of "nervous throat" was made. In the ensuing years he also became aware of a lump in the right side of the neck which gradually increased in size, slowly increasing shortness of breath on exertion and precordial pain with stooping or lifting.

Physical examination revealed moderate obesity and a mass in the thyroid. Fluoroscopic examination of the esophagus and esophageal motility studies revealed marked diffuse spasm which was felt to be the cause of his chest symptoms. No electrocardiogram was done preoperatively.

On April 22, 1960, thyroidectomy was performed without incident. On April 24, 1960, he had another episode of chest pain and choking on swallowing. An electrocardiogram was taken for the first time and revealed evidence of severe myocardial ischemia which persisted without change on serial tracings.

After his discharge from the hospital, he continued to have retrosternal discomfort now appreciated to be related to exertion, associated with pallor and sweating, relieved by rest and nitroglycerin, occasionally radiating into the left elbow and hand, and sometimes also brought on by swallowing of cold foods. The symptom pattern and the electrocardiogram changes were felt to be diagnostic of coronary artery disease. He noted very limited improvement on treatment for esophageal spasm and was therefore placed on coronary dilators.

**Comments**

The presence of diffuse spasm of the esophagus is often suggested by symptoms of a swallowed bolus being stopped part way down, painful eructation or retrosternal burning. It is less well appreciated that it may also cause severe precordial pain. In some cases this condition is associated with organic disease of the stomach, small bowel, gallbladder and esophagus and is possibly related to these. Specific treatment for these primary problems often benefits the esophageal symptoms. Yet, as demonstrated in most of our cases, there may be no evident primary disease. There-
Therefore, in the face of present knowledge, a diagnosis of idiopathic diffuse spasm of the esophagus commonly must be made and can thus be added to a considerable list of idiopathic, symptomatic functional disorders of the gastrointestinal tract. We have not had sufficient experience in this problem to make statements of any kind regarding possible psychodynamic considerations. Because of the location of the organ and the nature of its symptoms, it becomes an important consideration in the practice of cardiology.

The manifestations of this condition on esophageal motility studies are asynchronous, exaggerated, non-propagated esophageal contractions best described as violent and senseless. Such spasms quite logically may be acutely painful. Experience has shown that the degree of recorded spasm and the magnitude of the immediate symptoms are not predictably related. We have often visualized actual spasm of the esophagus on the monitoring scope at times when the patient is experiencing no symptom. At other times, severe symptoms have been clearly associated with the spasm pattern. There is nonetheless a fairly good association of these findings and variable chest symptoms. This disparity between observed dysfunction and overt symptomatology is commonplace in functional disorders of other viscera and does not preclude relating one to the other.

The exact mechanism of the pain response and its peculiar distribution in diffuse esophageal spasm is as poorly understood as the specific mechanism of pain in coronary artery disease. As indicated in our cases, there is a fairly good chance of confusing the two. In Case 7, the symptoms initially recorded appeared quite compatible with esophageal disease, yet the patient also had definite coronary artery disease. On the other hand, the first six cases gave reasonably good histories for coronary artery disease with four having radiation of pain to the left arm and shoulder, four having been at one time diagnosed as coronary artery disease, and all strongly suspected of and studied for coronary disease. Yet, all showed no evidence of heart disease and responded well to treatment for their esophageal spasm.

As Case 7 demonstrates, there can be more than one cause of symptomatic chest pain in any one patient, of which coronary artery disease always deserves careful consideration. Failure to appreciate this may prove embarrassing to the physician and unsatisfactory to the patient as it was in this case.

Diffuse esophageal spasm is not a serious threat to life or general body health. Yet, to diagnose it erroneously as coronary artery disease is a disservice to the patient not reflected in mortality figures. To consider it and positively diagnose it can materially and profitably reduce the number of diagnoses of chest pain of undetermined origin. Caution must always be exercised that the two conditions do not coexist. Admittedly, this possibility cannot be absolutely ruled out in any of our cases until further follow-up has been completed.

**Summary**

1. Diffuse spasm of the esophagus from undetermined cause may produce symptoms of severe chest pain easily confused with the symptoms of coronary artery disease as illustrated in these seven cases.

2. This diagnosis can be made positively by recording various patterns of esophageal dysfunction on esophageal motility studies.

3. The consideration and diagnosis of this problem may materially reduce the diagnoses of chest pain of undetermined origin.

4. In the present stage of our understanding of this problem caution must be exercised because of great symptomatic overlapping and possible coexistence of these two diseases.

**Resumen**

1. El espasmo difuso del esófago de causa indeterminada puede producir síntomas de grave dolor del pecho que se confunden fácilmente con síntomas de enfermedad coronaria, según se ilustra en siete casos.
2. Este diagnóstico puede asegurarse al registrar los diversos trastornos de la disfunción del esófago en estudios de su motilidad.
3. La consideración de esta posibilidad puede contribuir a disminuir la frecuencia de diagnósticos de dolor torácico de causa indeterminada.
4. Debe tenerse cuidad actualmente porque puede haber sobreposición sintomática y coexistencia de dos de estas enfermedades.

**Résumé**

1. Les spasmes généralisés de l'oesophage de cause indéterminée peuvent produire une forte douleur thoracique, facilement prise pour les symptômes d'une maladie coronarienne. 7 cas de ce type se sont présentés.

2. Ce diagnostic peut être fait par l'enregistrement de divers types de dysfonction oesophagienne, par des études sur la motilité oesophagienne.

3. La prise en considération et le diagnostic de ces faits peuvent réduire le nombre des douleurs thoraciques d'origine indéterminée.

4. Dans l'état présent de notre connaissance sur ce problème, l'attention doit être attirée sur les symptômes communs à ces deux maladies et à leur possible coexistence.

**Zusammenfassung**

1. Diffuser Spasmus des Oesophagus aus unbestimmter Ursache kann Symptome schwerer Brustschmerzen bewirken, die leicht verwechselt werden mit den Symptomen einer Coronar-Arterienkrankung, wie an diesen 7 Fällen dargestellt wird.


3. Die Berücksichtigung und Erkennung dieses Problems vermag die Diagnose eines Brustschmerzes unbestimmter Ursache erheblich zu verringern.


**Reference**


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**PLASMA TRIPLEPTIDASE ACTIVITY IN MYOCARDIAL INFARCTION**

Plasma tripleptidase activity was determined in 41 patients in the first 24 hours following the onset of myocardial infarction. In 95.1 per cent of patients, increased values were found. This test proved to be as sensitive as SGOT. The time course of both are the same in ten cases of coronary insufficiency. The mechanism of the change in tripleptidase activity after myocardial infarction was discussed.


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**MANAGEMENT OF PATIENT AFTER OPEN HEART SURGERY**

After open heart surgery, almost all patients demonstrate some degree of respiratory insufficiency which depresses myocardial function and causes arrhythmias. To avoid complications, we return patients still anesthetized to the recovery room and place them on the Engstrom respirator. Venous and aortic pressures are monitored continuously; arterial and venous blood gas levels and arterial pH are followed closely. The patient is kept on the respirator under minimal anesthesia or very light sedation until the ECG is stable, cardiac output is optimal, arterial oxygen tension is adequate, abnormal acid-base balance has been corrected, and blood volume and peripheral vascular tone no longer fluctuate widely. Only then is the patient permitted to wake. If necessary, the endotracheal tube is left in place and the respirator is continued through the first night. The following morning, if pulmonary insufficiency is still a significant problem, a tracheostomy is done and the respirator used as long as necessary.