

EARLY DIAGNOSIS OF PHLEBOTHROMBOSIS WITH AID OF A NEW CLINICAL TEST

Robert I. Lowenberg, M.D., New Haven, Conn.

Speculation has been endless in an attempt to determine why thromboembolism is still so prominent a cause of death. As early as 1934, John Homans¹ popularized the concept of pulmonary embolism originating in the leg veins and its prevention by venous interruption. He made the first clear differentiation of inflammatory from "bland" phlebitis. Ochsner and DeBakey² gave the latter the term phlebothrombosis. Homans also described a clinical test that has been helpful in establishing the diagnosis in doubtful cases. Following this lead, many studies have been made both in clinical and laboratory investigation, and numerous tests have been described. Venography was investigated and found unreliable. The advent of anticoagulant drugs served as an additional stimulus, and the persons studying the means of therapy divided; some favored surgical interruption of the venous system, and others favored the use of anticoagulant drugs. Despite all these advances, the overall incidence of pulmonary embolism has not appreciably changed in the past two decades, even with the use of anticoagulants and vein interruption procedures; some statistics even show an increase in the incidence. During this era, early ambulation has become routine, and close scrutiny by the house officers for signs of thrombosis has become a habit.

Since all this progress has been assimilated, why has the incidence of fatal and nonfatal pulmonary embolism not dropped precipitously? Is it the therapy that is lacking, or are the diagnostic facilities inadequate? Numerous additional explanations for this discrepancy have been advanced. Scrutiny of Roe and Goldthwaite's³ sta-

tistics for the Massachusetts General Hospital showed these figures for patients routinely admitted: from 1931 to 1935, 2.36% of the patients died of fatal pulmonary embolism; from 1936 to 1940, 3.33% died; and from 1943 to 1947, 2.54% died. During the years included in the latter two groupings, bilateral femoral vein ligations were being done at this hospital on small provocation; there was still no change in the rate of deaths that were caused by fatal pulmonary embolism. These authors also showed that from 1943 to 1947, there were 92 deaths from fatal pulmonary embolism; 49 (53%) of these were without warning, despite the fact that the house officers were on the alert and extensive therapeutic programs were in progress. In Belt's series⁴ of deaths resulting from pulmonary embolism, 90% of the patients on whom autopsy was done were not known to have had any thromboembolic disease. Barker's group⁵ found that 85% of their patients with fatal embolism died without premonitory signs. Dehlinger and Riemenschneider⁶ found that 92% of the patients on whom autopsies were later done showed no signs and symptoms requiring specific therapy. In the series reviewed by Ravdin and Kirby,⁷ thromboembolism was first recognized in 74% of the patients after massive pulmonary embolism. The 12 year survey at the Charity Hospital⁸ (New Orleans) showed that over 75% of patients dying of pulmonary embolism showed no leg signs; 50% of the patients who died had chest signs of some type. Zimmerman and his colleagues⁹ reviewed the deaths from fatal pulmonary embolism for 17 years. These data were collected from the Michael Reese and Chicago Memorial hospitals. In this series 94% of deaths occurred in patients who were at no time suspected of having any type of intravascular clot. These figures would indicate, therefore, that significant numbers of patients have this condition without its being recognized.

CLINICAL PICTURE

Apparently the clinical signs in the patients that died without warning were negligible. No adequate laboratory test is available. Patients who have the classical phlebothrombosis may not show the following accepted clinical signs, which would help to establish the diagnosis of phlebitis: leg pain, swelling, redness, heat, increased vasomotor tone, superficial venous congestion, dilated pretibial veins,¹⁰ tenderness on calf compression, tenderness on deep calf compression (against tibia), tenderness on deep plantar surface of foot, vessel tenderness, pain on dorsiflexion, pain on calf muscle rocking, and the cough-pain sign.¹¹

De Takats¹² showed that in 20 to 25% of his cases, the first embolus was the fatal one. Classical embolic phenomena are believed to be present if there has been sudden chest pain, pain on respiration, sudden hemoptysis, rib cage tenderness, or an x-ray shadow suggestive of infarction. Since there is a very large group of cases

From the Surgical Service of the Grace-New Haven Community Hospital.

Drs. Gustav E. Lindskog, Alfred Hurwitz, Courtney C. Bishop, Louis H. Nahum, and Samuel Climo assisted in the preparation of this manuscript and gave permission to see some of their patients.

1. Homans, J.: Thrombosis of the Deep Veins of the Lower Leg, Causing Pulmonary Embolism, *New England J. Med.* **211**: 993-997, 1934.

2. Ochsner, A., and DeBakey, M.: Therapeutic Considerations of Thrombophlebitis and Phlebothrombosis, *New England J. Med.* **225**: 207-227, 1941.

3. Roe, B. B., and Goldthwaite, J. C.: Pulmonary Embolism: Statistical Study of Post-Mortem Material at Massachusetts General Hospital, *New England J. Med.* **241**: 679-686, 1949.

4. Belt, T. H.: Thrombosis and Pulmonary Embolism, *Am. J. Path.* **10**: 129-144, 1934.

5. Barker, N. W.; Nygaard, K. K.; Walters, W., and Priestley, J. T.: A Statistical Study of Postoperative Venous Thrombosis and Pulmonary Embolism: Time of Occurrence During Postoperative Period, *Proc. Staff Meet., Mayo Clin.* **16**: 17-21, 1941.

6. Dehlinger, K., and Riemenschneider, P.: Pulmonary Embolism: Analysis of 74 Autopsy Cases Since 1941, *New England J. Med.* **240**: 497-501, 1949.

7. Ravdin, I. S., and Kirby, C. K.: Experiences with Ligation and Heparin in Thromboembolic Disease, *Surgery* **29**: 334-341, 1951.

8. Ochsner, A.; DeBakey, M. E.; De Camp, P. T., and da Rocha, E.: Thrombo-Embolism: An Analysis of Cases at the Charity Hospital in New Orleans over a 12-Year Period, *Ann. Surg.* **134**: 405-419, 1951.

9. Zimmerman, L. M.; Miller, D., and Marshall, A. N.: Pulmonary Embolism: Its Incidence, Significance, and Relation to Antecedent Vein Disease, *Surg., Gynec. & Obst.* **88**: 373-388, 1949.

10. Moses, W. R.: The Early Diagnosis of Phlebothrombosis, *New England J. Med.* **234**: 288-291, 1946.

11. Lawrence, E. D.: The Cough-Pain Sign in Acute Superficial Thrombophlebitis, *J. M. Soc. New Jersey* **47**: 164-166, 1950.

12. De Takats, G., and Fowler, E. F.: Problem of Thrombo-Embolism, *Surgery* **17**: 153-177, 1945.

first diagnosed in the autopsy room,¹³ the patients with few or no signs and symptoms are the ones who most urgently require surgical or medical procedures to prevent extension of their phlebitic process. In phlebothrombosis as defined by Ochsner and DeBakey, there is commonly no color or skin temperature change, no swelling, no fever, and only occasionally an ache in one limb. The diagnosis then becomes a delicate problem, based solely on elevation of temperature, pulse rate, leukocyte count, and sedimentation rate. The attending physician and the house officer must rely on the thoroughness of their examination of the lower extremities and their interpretation of these findings. This is often very difficult, and usually several members of the attending or house staff will disagree as to the diagnosis. If the house officer is armed with a test that is quantitative and that has an end point, he and his fellow house officers will always concur in the diagnosis. Such a test is available.

SPHYGMOMANOMETER CUFF PAIN TEST

For the past four years, I have used a very simple test for confirming the diagnosis in doubtful cases of phlebothrombosis and for predicting the onset of phlebothrombosis in other instances. The use of this test is superfluous when the diagnosis of thrombophlebitis is obvious. The value of this test in following surgical cases as well as those of hospitalized or invalid patients will be immediately apparent. The only equipment necessary is a sphygmomanometer. In patients suspected of having phlebothrombosis, the pneumatic cuff is placed about the calf or thigh and slowly distended; distention of the cuff should be accomplished in 10 to 15 seconds. Normally patients do not register discomfort below 180 mm. Hg over the calf or thigh. In the presence of phlebitis, the patient will complain bitterly of pain at a level significantly below the normal. At this point the cuff is immediately deflated, and the test is repeated on the other calf. If doubt exists in the examiner's mind about the patient's interpretation of pain, he need only repeat the test on the patient's arm. Most patients will tolerate 250 mm. Hg on the arm without complaint. When the sphygmomanometer cuff pain test is done as part of the physical examination, one simply proceeds from blood pressure determination to leg testing. In general, the patient is not alerted to any impending calf pain. He is watched for alteration of facial expression or a withdrawal reaction. With the first pain, the patient may withdraw by flexing his thigh.

A positive sphygmomanometer cuff pain test is recorded when there is a clear-cut patient pain response anywhere from 60 to 150 mm. Hg. This can be repeated for clarification, and the end point should be within 10 mm. Hg of the previous recording. Discomfort is registered always in the segment of extremity covered by the pneumatic cuff. The patient will usually relate to the examiner that the cuff was tighter at the strongly positive location than at the same position on the other leg, although the pressure might have been 100 millimeters less. One or two repetitions of the test without pause do not seem to alter its sensitivity or the pathological process underlying.

The sphygmomanometer cuff pain test as described above has now been done on about 350 patients, some in the hospital and some in the office. One hundred sixty-nine patients with positive tests have been classified as having primary or secondary vascular disease. The diagnoses of the diseases of the 93 patients who had primary vascular disease follow.

Thrombophlebitis	85
Superficial	38 *
Deep	17
Phlebothrombosis	28
Varicose veins	6
Postphlebitic syndrome	12
Elephantiasis	4
Thrombosis in vena cava	1
Pulmonary embolism	7
Nonfatal	6
Fatal	1

* Two of these patients had thromboangiitis obliterans.

Seventy-six patients had secondary vascular disease: an intravascular clot was diagnosed clinically either at the time of the sphygmomanometer cuff pain test or subsequently. The primary conditions with which vascular disease was associated are listed below.

Parturition (ante partum) *	3
Parturition (post partum)	10
Vaginal delivery	9
Caesarean section	1
Surgery	10
Contusions to trunk	6
Contusions to extremities without fracture or dislocation	34
Electroconvulsive therapy	2
Amputation (disease in remaining extremity)	8
Erythema due to sunburn	1
Gout	2

* One patient had congenital hemolytic icterus.

This test has served as a screening mechanism in many cases and as a method of confirming a clinical impression in others. It has been done from one to several times daily without untoward result. It has never resulted in pulmonary embolism and has never noticeably influenced the course of the patient's disease unfavorably. In the entire series, only one patient has complained (on two occasions) that she had increased discomfort the day after the test.

Studying a large number of patients by this method would seem to indicate that false positive results occur. This may be more apparent than real, however, if we agree with Neumann¹⁴ that 50 to 60% of adults carry thrombi in plantar or calf veins. Rössle¹⁵ believes that 27% of people over 20 years of age have thrombi in their leg muscles. This concept is bolstered by the number of cases in which apparently minimal trauma produces thrombophlebitis or phlebothrombosis. Further support for this concept is the knowledge that phlebitis frequently starts very soon after bed rest is instituted or immediately postoperatively. False positive results probably occur in conditions producing muscle cramps, for example, pregnancy. Direct trauma to the lower extremity may also produce a false positive test; some of these patients, however, on closer scrutiny will show occult signs of phlebitis. Patients with intermittent claudication and other conditions resulting in calf tenderness should have a con-

13. DeBakey, M. E.: Collective Review: A Critical Evaluation of the Problem of Thromboembolism, *Internat. Abstr. Surg.* **98**: 1-27, 1954.
 14. Neumann, R.: Ursprungszentren und Entwicklungsformen der Bein-Thrombose, *Arch. f. path. Anat.* **301**: 708-735, 1938.
 15. Rössle, R.: Ueber die Bedeutung und die Entstehung der Wadenvenenthrombosen, *Arch. path. Anat.* **300**: 180-189, 1937.

trol test made at the beginning of their hospitalization. Marked changes in their response to the sphygmomanometer cuff pain test are of greater significance than a single observation of a positive test at a time when a diagnosis of intravascular clotting is suspected.

False negative results were not encountered in this series. In no patient who had a negative test did clinical leg thrombophlebitis or pulmonary embolism develop. One patient was seen after a classical pulmonary embolus had developed. She had a negative sphygmomanometer cuff pain test over both calves. The left antecubital space at the site of an intravenous infusion was the center of an extensive thrombophlebitic process; this was apparently the origin of the pulmonary embolus.

Certain modifications of the sphygmomanometer cuff pain test as described above are worthy of mention. The test may be applied to the thigh or to the foot as well as to the calf. The latter observations are just beginning to accumulate, but the early results of thigh testing coincide with the observations of McLachlin and Paterson,¹⁶ who demonstrated pathologically that 73% of cases of phlebitis originate in the thigh and pelvis. I have followed patients through to a negative test over the calf only to observe a positive test still present over the thigh. Plantar phlebitis is evidenced by a positive test over the foot.

REPORT OF CASES

CASE 1.—A 60-year-old white housewife struck the posterior part of her left calf on a crate on Nov. 21, 1953, while she was shopping. Ten days later she had sudden pain as though "struck by a rock in the back of the left leg." The next day she noted swelling of the left ankle, which increased as the day went on. Walking and bed rest gave her relief. Examination on Dec. 7, 1953, showed 1.5 cm. swelling of the left calf and 0.7 cm. swelling of the left ankle. Dorsiflexion caused no discomfort. A sphygmomanometer cuff pain test over the left calf produced sharp pain at 70 mm. Hg but none at 200 mm. Hg on the right calf. The patient was admitted to the St. Raphael's Hospital and given heparin and bishydroxycoumarin (Dicoumarol). Two days after bed rest was instituted, vessel tenderness was noted bilaterally. The test at this time was positive over both calves and both thighs, right thigh at 140, left thigh at 110, right calf at 120, and left calf at 80 mm. Hg. Rapid improvement was noted thereafter and continued as the patient was allowed to walk. Exhaustive search was made for occult malignancy, but none was found. The patient was discharged from the hospital in 12 days, at which time the test was positive at 160 mm. Hg on the left calf only. Anticoagulants were given while the patient was at home. When she was last seen, no swelling was present, and the test was negative throughout both legs.

CASE 2.—A 72-year-old white rolling mill operator was admitted on Jan. 4, 1954, to the Derby Hospital with marked varicose veins and arteriosclerosis obliterans. A right lumbar sympathectomy was done with good results. On the fifth day postoperatively the patient complained of pain in the right leg. Examination showed a superficial phlebitis with some swelling of the right calf and right ankle. A sphygmomanometer cuff pain test was positive on the right calf at 100 mm. Hg (the cuff was not placed over the inflamed segment). The patient was given heparin and the phlebitic process was reduced. He was discharged on the 10th postoperative day; the superficial phlebitis had subsided, and the swelling had gone down. The test on discharge was still positive at 150 mm. Hg over the thigh. When the patient was seen in the office three weeks postoperatively, sphygmomanometer cuff pain was recorded at 130 mm. Hg over the right thigh and 180 mm. Hg over the right

calf. The test on the left leg was negative. The remaining tenderness was interpreted as indicative of residual vasculitis, and the patient was kept under observation.

CASE 3.—A 39-year-old white telephone lineman returned to the office on Jan. 29, 1954, because of pain in the left ankle of four weeks' duration. This patient had had two episodes of spontaneous superficial thrombophlebitis, one in each leg, the last occurring in November, 1951. A diagnosis of thromboangiitis obliterans was proved by the examination of the pathological specimen at that time at the Grace Hospital. The sphygmomanometer cuff pain test was 120 mm. Hg on the left calf and left thigh and negative on the right leg. No superficial phlebitis and no other positive signs were seen. Treatment with vasodilator medication and elimination of smoking resulted in gradual improvement. This patient will be seen periodically in the future.

CASE 4.—A 58-year-old white housewife was operated on for very severe varicose veins at the Grace Hospital on July 31, 1952. On Dec. 11, 1953, she was seen in the office for a painful, swollen right ankle. This ankle had struck a hard object two weeks previously. The ankle appeared red and swollen, and deep calf tenderness was noted. The sphygmomanometer cuff produced sharp pain over the right calf at 70 mm. Hg. On the left calf, pain was not produced at 200 mm. Hg. The patient was admitted to the St. Raphael's Hospital, and anticoagulant therapy was given with the use of heparin and bishydroxycoumarin. Six days later the patient was discharged with the swelling gone and the test negative bilaterally. Follow-up in the office has showed no recurrence.

CASE 5.—A 61-year-old white male furniture dealer was seen in 1952 for a flare-up of a postphlebitic syndrome on the left side. The patient returned on Jan. 4, 1954, giving a history of an injury to the posterior portion of the left leg three weeks previously. Soreness and swelling were present despite the use of an elastic stocking. Over the lateral aspect of the left leg a reddish nodule about 0.5 in. (1.27 cm.) square was found. The nodule was tender to touch, and the left calf measured 0.75 in. (1.91 cm.) larger than the right. There was a definitely positive sphygmomanometer cuff pain test over the left calf at 150 mm. Hg (above the level of the nodule). The opposite calf was asymptomatic at 210 mm. Hg. The patient was kept ambulatory and given vasodilator medicaments. Four days later the pain was reduced and the test negative. The patient was discharged symptom-free a week later.

CASE 6.—A 69-year-old retired white man was seen on Aug. 5, 1952, because of a painful, hot, swollen right leg. Two weeks previously he had noted the onset of redness and tenderness on the medial part of the right leg. Three days later he found a "tubular" mass in the medial part of the thigh and noted the onset of ankle swelling. He had chest pain about this time with exacerbation on deep inspiration. Two years previously he had had a similar process on the medial portion of the left leg. Tenderness was elicited over the medial portion of the right thigh. Discomfort on dorsiflexion and calf tenderness were not found. Sphygmomanometer cuff distention over the calf was painful at 150 mm. Hg bilaterally. The picture reverted to normal with conservative management, and the test became negative.

CASE 7.—A 20-year-old white receptionist was seen first on May 17, 1951, the day after a sprain of her right ankle. Examination showed 0.13 in. (0.32 cm.) swelling of the right calf. Dorsiflexion caused discomfort, and tenderness was present in the deep calf, sole of the foot, and the popliteal space. (The sphygmomanometer cuff pain test was not done at that time.) Smoking was stopped, and anticoagulant therapy was started. Recovery was complete by June 22, 1951. On Aug. 23, 1951, she began to have pain in the right calf. Four days later there was also some pain in the left calf relieved by assuming a recumbent position. Examination at this time showed no swelling. Dorsiflexion produced no pain, and calf tenderness was absent. A sphygmomanometer cuff pain test over the calves produced pain at 130 mm. Hg on the right and 150 mm. Hg on the left. Smoking was stopped and vasodilator medication started; the patient recovered by Sept. 13, 1951. Subsequently, there were two remissions, each lasting 10 to 14 days. Between

16. McLachlin, J., and Paterson, J. C.: Some Basic Observations on Venous Thrombosis and Pulmonary Embolism, *Surg., Gynec. & Obst.* 93: 1-8, 1951.

these she had attacks of temporal arteritis. The two conditions seemed to alternate with each other. Symptoms cleared by Nov. 2, 1951, the test was negative, and the patient was discharged.

CASE 8.—A 53-year-old retired nurse, weighing 275 lb. (124.7 kg.), was seen on March 13, 1953, because of constant painful swelling of both legs of two years' duration. Ten years previously the patient had a prolonged period of bed rest for a "heart ailment" and had "phlebitis" at that time. When she was seen she had pain and swelling without redness, more on the right than on the left leg. Examination showed induration with spotty tenderness on the right leg and bilateral pigmentation. Sphygmomanometer cuff pain test at that time was painful over both calves at 80 mm. Hg. The patient was admitted to the St. Raphael's Hospital, and bilateral superficial femoral vein interruption was done on March 14, 1953. There was reduction of pain and swelling. Subsequently she has had a return of the symptoms, which have been very refractory to therapy. The patient has unsuccessfully attempted to lose weight, but has derived some relief from the use of adjustable canvas leg supports.

CASE 9.—A 67-year-old white farmer had a saucerization of an osteomyelitis of the right femur on Nov. 18, 1953. Prior to discharge from the Griffin Hospital, the patient was noted to have slight swelling of the right ankle and was therefore given intermittent anticoagulant therapy. He was seen at home on Nov. 28, 1953, because of pain in the left leg (the one previously unaffected) and swelling of the right ankle. Examination showed slight bilateral discomfort on dorsiflexion. Deep calf tenderness was present bilaterally. Sphygmomanometer cuff produced pain in the left calf at 110 mm. Hg and on the right at 130 mm. Hg. The patient was readmitted to the Griffin Hospital, anticoagulant therapy was reversed, and bilateral superficial femoral vein interruption was performed. The postoperative course was uneventful. The sphygmomanometer test showed less reaction within three days and the results gradually returned to normal.

CASE 10.—A 33-year-old white male aircraft worker was seen on Dec. 28, 1953, because of a "burning pain" in the right medial part of the thigh that had been present for two to three weeks with a gradual increase in symptoms. Examination showed a patchy erythema along the right medial mid thigh to the knee. This was broader and more diffuse than a lymphangitis. No swelling was found. Tenderness was present over the right femoral triangle, markedly over the right Hunter's canal, and very slightly over the left Hunter's canal. The calves showed no abnormalities, and dorsiflexion was performed without discomfort. The sphygmomanometer cuff pain test was negative over the right calf and the left thigh. Pain was elicited at 60 mm. Hg over the right thigh and at 140 mm. Hg over the left calf. The patient was admitted to the St. Raphael's Hospital, put on a regimen of bed rest, and given heparin and bishydroxycoumarin. Two days later there was swelling of the right calf with palpably thickened veins and marked tenderness on deep palpation. Following this, improvement was noted, and calf tenderness decreased and then disappeared. Progressive improvement was noted in sphygmomanometer testing. The right thigh was slightly painful at 170 mm. Hg at the time of discharge, 11 days after admission. During the patient's hospital stay, a thorough search was made for occult cancer, but none was found.

CASE 11.—A 30-year-old white engineer was first seen on May 29, 1953. Three months previously he began to have aching in the medial part of the right thigh. Redness and soreness followed, and two hard red lumps appeared. One week previously he had a "prickly sensation" in the medial part of the left arm that was followed by the appearance of redness and tenderness. Examination showed a 5.5 in. (13.97 cm.) stretch of thrombosed great saphenous vein in the right thigh. A penny-sized area of induration and thrombosis was found just above the left elbow. Sphygmomanometer cuff distention produced pain at 120 mm. Hg on the left calf and at 100 mm. Hg on the right calf. With conservative therapy the arm lesion resolved, but the right leg phlebitis jumped on two occasions to other locations. At this point the patient was admitted to the New Haven Hospital, and saphenous vein ligation was done. A specimen removed at that time was consistent pathologically

with a diagnosis of thromboangiitis obliterans. Twelve days postoperatively the patient had a bout of inflammation in the left great saphenous vein that subsided in two days with conservative treatment.

CASE 12.—A 44-year-old white painter hit his right shin on a metal table on Jan. 23, 1954. After the injury the leg bled and subsequently swelled. When he was seen in the office three days later, he complained of pain for 5 cm. about the abrasion. Examination revealed 0.5 in. (1.27 cm.) swelling of the right calf, and 0.63 in. (1.62 cm.) swelling of the right ankle. Superficial ulceration 0.5 by 0.75 in. (1.27 by 1.91 cm.) in size was present over the lower one-third of the right tibia. Dorsiflexion caused no discomfort on either side. Deep calf tenderness was present, and plantar tenderness could be elicited. Sphygmomanometer cuff distention was not painful over either thigh or over the left calf. Over the right calf, however, it produced pain at 80 mm. Hg. Three days later, left calf compression produced pain at 120 mm. Hg. On Feb. 1, 1954, the right calf was positive at 120 mm. Hg, and the left calf showed negative results. Therapy consisted of ambulation, administration of antibiotics, and elastic supportive bandages.

CASE 13.—A 32-year-old Negro housewife was in an auto accident on Jan. 3, 1954. She hit her chest on the dashboard and was thrown to the floor. Both legs hurt immediately after the accident, but the next day this pain had disappeared. On examination on Jan. 4, 1954, she was having a lot of pain along the right anterior rib margin. This was increased with coughing and breathing. Examination revealed tenderness over the ziphoid process and both costal margins. Sphygmomanometer cuff distention produced pain over the left calf at 170 and over the left thigh at 140 mm. Hg. The right leg was negative to the test. Four days later there was noted tenderness over the midportion of Hunter's canal bilaterally, and testing at that time produced pain over the left thigh at 120 and over the right thigh at 140 mm. Hg. On Jan. 14, 1954, the patient made her first complaint referable to the legs. Prior to this she referred her complaints entirely to the chest wall. At that time she noted pain in the left calf and thigh and tenderness in the medial part of the calves. Examination showed left calf tenderness and vessel tenderness in the left thigh. Sphygmomanometer cuff distention at that time produced pain over the left calf at 130 and over the left thigh at 100 mm. Hg. The right thigh was tender at 180 and the right calf negative at 210 mm. Hg. On Jan. 25, 1954, three weeks after the first positive sphygmomanometer cuff pain test, there was palpable thickening in the left calf. Ten days later there was swelling of the left ankle and calf pain. Testing at that time was painful over the right thigh at 100, over the left thigh at 110, the right calf at 140, and the left calf at 150 mm. Hg. Conservative therapy only had been given. This process was still active at the time this report was written.

CASE 14.—A 62-year-old white female machine operator was hit by a car on Sept. 25, 1953. The patient landed on her right knee and right side. After this her right leg and ankle swelled, and they remained so up to Dec. 19, 1953, when the patient was first seen. Roentgenograms had been taken, and no fractures or dislocations were found. Examination showed 0.87 in. (2.22 cm.) swelling of the right calf and 0.75 in. (1.91 cm.) swelling of the right ankle by comparison with tests made on the left leg. A 1.62 by 1.25 in. (1.59 by 3.18 cm.) pigmented scar was present just below the right patella. Slight tenderness was noted just above the knee on the medial aspect of the right thigh. Dorsiflexion caused no discomfort on either side. Pneumatic cuff compression produced pain on the right thigh at 130 mm. Hg and on the left thigh at 140 mm. Hg. Both calves were pain-free at 210 mm. Hg. On Dec. 31, 1953, after vasodilator medication and elastic support for 12 days, tenderness was elicited over the lower one-half of Hunter's canal on the right. Testing was not painful on the left thigh but did show pain at 140 mm. Hg on the right thigh. On Jan. 15, 1954, pain was noted at 160 on the left thigh and at 140 mm. Hg on the right thigh. On Jan. 29, 1954, the respective readings were 120 and 80 mm. Hg. On Feb. 18, simultaneous, bilateral, complete leg venography was performed. Comparison of the venous pattern of the two legs showed evidence of deep venous pathological conditions in the right leg. This patient is still under observation.

COMMENT

When the surgical approach is elected in the treatment of phlebitis of the leg, the accepted procedure has been bilateral femoral vein ligation. This is so because it has been proved pathologically that bland thrombi exist in the apparently uninvolved extremity and very frequently are the cause of fatal pulmonary embolism. The sphygmomanometer cuff pain test is the only clinical test that substantiates these observations, for in most patients with clinically unilateral phlebitis the test is positive bilaterally, though to a lesser degree in one leg. (In doubtful cases, the entire house staff sees a particular patient and makes the diagnosis with the aid of this test.) When the sphygmomanometer cuff pain test is negative preoperatively and becomes positive after the patient has had surgery, immediate therapy is demanded. This indication is perhaps one of the greatest values of this test. Frequently, several days after the test has become positive, more overt signs of the phlebotic process will become manifest, particularly in untreated patients. Daily testing may also be used to follow the progress of the process. In most cases complete healing will be accompanied by a negative test, although the test will remain positive after other clinical signs have disappeared. Patients with obvious thrombophlebitis usually show a positive sphygmomanometer cuff pain test on the apparently unafflicted extremity.

Routine testing of office patients has also been done on a small scale. Patients with minor illnesses and with symptoms referable to other parts of the body have made up a large part of the control series. It is very interesting to note that several unexpected positive sphygmomanometer cuff pain tests were recorded. In some of these patients, subsequent examination showed calf swelling, localized deep calf tenderness, vessel tenderness, or a combination of these. Detailed examination of the legs in these cases would not ordinarily have been indicated. Studies are presently being conducted in an attempt to understand more fully the significance of these occult signs.

SUMMARY

A review of statistics from several large series indicates a continuing death toll from pulmonary embolism. In a high percentage of these cases of fatal pulmonary embolism, phlebitis was unsuspected.

A simple clinical test for detecting phlebothrombosis before other signs are present may be made. Subjectively, the sphygmomanometer cuff pain test is positive when the patient complains of pain. Objectively, this test is positive when the patient grimaces or withdraws the limb. The objective and subjective end points are close together. This test requires no special equipment and no elaborate training. It has a sharp end point.

245 Edwards St.

DELAYED OPERATIVE MANAGEMENT OF ACUTE CHOLECYSTITIS

Henry Doubilet, M.D., George Reed, M.D.

and

John H. Mulholland, M.D., New York

There are two divergent opinions in the United States regarding the surgical management of acute cholecystitis. Those with one viewpoint prefer to operate early or during the stage of acute inflammation,¹ while the others intervene only after all acute manifestations have subsided.² The conclusions of both are based on empirical factors such as experience, statistical analysis of results, morbidity, and mortality. Unfortunately, basic information on the causes of gallbladder disease in general and the precipitation of acute complications in the course of such disease is lacking. Statistical studies are weakened by the nonobjective, vague criteria for the diagnosis of acute cholecystitis, by the foreboding implications in such terms as gangrene and perforation of the gallbladder, and by the absence of valid statistics on the complications resulting from technical errors at operation. To some,

the concept of delayed operation implies that the acute phase of the illness goes untreated. This is untrue. Active measures based on sound principles can be taken that will reverse the inflammatory process and promote rapid recovery.

The physiological considerations that should form the basis for treatment may be summarized as follows. The gallbladder is part of a complex gastrointestinal mechanism of common embryologic origin that comprises the duodenum and stomach, the pyloric sphincter and the sphincter of Oddi, the bile and pancreatic ducts, and the glands that secrete digestive juices in the stomach, liver, and pancreas. Gallbladder disease is accompanied and, perhaps, instigated by disorders elsewhere in this system. There is evidence that many instances of acute cholecystitis are associated with the diversion of pancreatic juice into the gallbladder by spasm of the sphincter of Oddi, when the pancreatic duct opens into the common bile duct. The element of pain in acute cholecystitis that is due to inflammation of the parietal peritoneum can be reproduced precisely by distention of the bile ducts after the gallbladder has been removed. This fact would indicate that operative removal of the gallbladder is an empirically successful procedure in many but not all instances and that the origin of the pain is not attacked directly. The dynamics of flow of bile, of sphincter of

From the Department of Surgery, New York University College of Medicine, and the Third (New York University) Surgical Division of Bellevue Hospital.

This study was aided by a grant from the United States Public Health Service.

1. (a) Buxton, R. W.; Ray, D. K., and Coller, F. A.: *Acute Cholecystitis*, J. A. M. A. **146**: 301 (May 26) 1951. (b) Glenn, F.: *The Surgical Treatment of Acute Cholecystitis*, Surg., Gynec. & Obst. **90**: 643, 1950. (c) Dunphy, J. E., and Ross, F. P.: *Studies in Acute Cholecystitis: Surgical Management and Results*, Surgery **26**: 539, 1949.

2. (a) Mustard, R. L., and Custer, H. R.: *The Management of Acute Cholecystitis*, Surg., Gynec. & Obst. **95**: 59, 1952. (b) Holden, W. D.; Cebul, F. A., and Loughry, C. W.: *Management of Acute Disorders of the Biliary Tract*, J. A. M. A. **148**: 879 (March 15) 1952.