CRURAL THROMBOSIS FOLLOWING ASEPTIC CELIOTOMY.

By Henry C. Coe, M.D.,
New York.

Among the later complications of abdominal section for disease of the pelvic organs there is none that causes more annoyance to the surgeon and disappointment to the patient than the one which will be briefly discussed in this paper. Occurring, as it often does, in simple cases in which a rapid recovery had been confidently expected, and at the end of the first or beginning of the second week, when all anxiety regarding the condition of the patient has been dismissed, its appearance is as unexpected as it is unwelcome. One whose surgical training has rendered him skeptical regarding the development of post-operative thrombosis from general causes at once thinks of local sepsis, his suspicions being strengthened by the detection of an induration in the broad ligament, or at the site of the stump, on the affected side, and he begins to review his technique carefully in search of some broken link in the chain. If other sources of infection can be excluded he is apt to infer that his catgut was faulty, since it is well known that the centre of the coarser sizes may be imperfectly sterilized and may not manifest its dangerous qualities until sufficient time has elapsed to allow the aseptic peripheral portion to become dissolved. Even though the bacteriological examination of the suspected piece is negative, it is impossible for him to dismiss the notion that there is a septic element in the case. Since there is, fortunately, no opportunity for post-mortem investigation, he is obliged to

base his opinion entirely on clinical evidence, which is itself largely negative.

That there is a general disposition to regard crural thrombosis following abdominal section as being purely of septic origin, and practically identical with the milder grade of puerperal phlegmasia dolens, once so familiar to obstetricians, is shown in the brief allusions to this complication in many text-books and monographs. Kelly and Greig Smith, however, representing the most advanced teaching in abdominal surgery, carefully avoid using the word sepsis in this connection. The latter, in the last edition of his well-known work, devotes only eight lines to the subject of "edema of the legs," concluding with this statement: "Most cases could doubtless be explained by some traumatism or compression of a venous trunk in the pelvis by forceps or ligature; a few might arise from pelvic cellulitis or angeioleucitis."

This explanation is plausible, but far from convincing, since it fails to account for the comparatively rare occurrence of thrombophlebitis after total extirpation in bad pus cases, in hysterectomy, myomectomy, and especially in puerperal hysterectomy, where there is always marked dilatation of the vessels of the broad ligaments and mass-ligatures and clamps are so freely employed. Certainly, if traumatism played an important part the use of the angiotribe would seem to be especially favorable to the development of this condition, which is not the case. As this paper is essentially clinical, I shall not burden you with a consideration of elementary facts regarding the nature and causation of thrombosis and phlebitis or review the various theories of Virchow, Cornil et al. The subject is quite an old one, and reference to the English journals as far back as the early fifties shows that puerperal phlegmasia had been carefully studied at that time. Opposing papers by Lee, MacKenzie, and Tilbury Fox[1] furnish interesting reading from a historical, if not from a scientific, stand-

[1] British and Foreign Medico-Chirurgical Review, 1854, p. 55; Medical Times and Gazette, vol. ii., 1862, p. 46.

point. Lee and Fox regarded phlegmasia as a local and MacKenzie as a constitutional affection. H. Lee, in an earlier paper,[1] had already opposed the view of extension of a septic clot from the uterus, and affirmed his belief that crural phlegmasia was the local expression of a blood infection. This seems to have been the general opinion at this time, as it was reaffirmed by J. Y. Simpson.[2] Vaquez's monograph[3] is a distinct addition to the literature of this subject, and contains many suggestive sentences, which I would like to quote if time permitted. He takes issue with Virchow, agreeing with Widal[4] that phlegmasia is due to infection even in the mild cases which are attended with slight chills and moderate elevation of temperature. He is somewhat confusing, since in another place he refers to "aseptic" phlebitis following ligation or other injury to a vein, and states that an aseptic thrombus may subsequently become infected. The micro-organisms found in the thrombus, he states, may be identical with those at the original focus of infection, or they may be a different variety, invading the vein from without by way of the vasa vasorum. Thrombosis, he concludes, is not a simple clotting of blood, but is always secondary to phlebitis. It is interesting to note that he regards it as a rare complication of simple ovariotomy.

Of all the papers which I have read Wyder's gives the most information regarding thrombosis following aseptic celiotomy. His article on "Embolie der Lungenarterien in der geburtshilflich-gynækologischen Praxis"[5] is based on twelve cases with eight deaths, which were carefully investigated post-mortem. Unfortunately, no bacteriologic examinations were recorded. As the author says, they furnish a startling commentary on the unavoidable dangers of abdominal section. The gynecological cases are so interesting that I venture to insert brief abstracts of them.

[1] British and Foreign Medico-Chirurgical Review, 1851, p. 111.
[2] Medical Times and Gazette, 1859, vol. i. pp. 567 and 619.
[3] Clinique Médicale de la Charité, 1894.
[4] Thèse de Paris, 1889.
[5] Sam. klin. Vorträge, No. 146.

CASE I.—Virgin, aged forty years, with old varicosities and edema of both legs. Interstitial fibroid the size of the fist. Castration. Operation simple, and afebrile convalescence up to the fifth day, when the patient complained of sharp pains in the left foot. She expired suddenly on the same night. Autopsy showed partly decolorized thrombus in the left saphenous, extending into the femoral. Pelvic veins normal. Emboli in the main branches of both pulmonary arteries.

CASE II.—Virgin, aged forty-four years. Castration for fibroid the size of a child's head. Operation simple. Convalescence normal until the fourteenth day, when the heart-action became rapid and irregular, and she died in a few minutes. At the autopsy the veins in both stumps were thrombotic, and the main branches of the pulmonary arteries were plugged with fresh emboli. Marked dilatation of the left ventricle.

CASE III.—Virgin, aged thirty-four years. Supravaginal amputation of the uterus for multiple fibroids, with extraperitoneal treatment of the stump, the operation being uncomplicated. Afebrile recovery until the eighth day, when she expired, with symptoms of pulmonary asphyxia. The left hypogastric vein contained a thrombus, and both pulmonary arteries were plugged.

CASE IV.—Primipara, aged thirty-eight years. Removal of the adnexa and ventrofixation. No symptoms until the eleventh day, when the patient was feeling quite well. She was suddenly attacked with dyspnea and died. Autopsy unsatisfactory, as the source of the emboli could not be discovered.

CASE V.—Multipara, aged thirty-nine years. Removal of intraligamentary ovarian cystoma of the left side, also the right tube and ovary. No symptoms until the tenth day, when the patient complained of feeling bad, and died in ten minutes. Numerous thrombi were found in the veins on the left side of the pelvis, extending into the left hypogastric. Emboli in both pulmonaries.

CASE VI.—Explorative section for carcinoma of the ovaries and peritoneum. Normal convalescence until the seventh day, when sudden death occurred, with cyanosis. Thrombus (presumably old) in the vena cava inferior, with pulmonary emboli.

CASE VII.—Virgin, aged twenty-seven years, in robust health. Ventrofixation after removal of the left tube and ovary. Convalescence entirely normal until the seventh day, when she had an attack of dyspnea, with rapid pulse, from which she rallied. Two other attacks occurred during the night, attended with severe pain under the left scapula, the third terminating fatally. The left pulmonary artery contained a recent embolus, but its origin could not be found. The writer believed that the accident was directly due to the operation, and that a thrombus must have developed in the veins of the stump, which had been completely dislodged, leaving no trace.

In summarizing Wyder states his belief that thrombosis in both the pelvic and crural veins is not uncommon after celiotomy, but that the thrombi are generally absorbed if they do not become infected. They are by no means confined to complicated operations, as shown by his cases. In general, pulmonary emboli are due to thrombi in the pelvic rather than in the crural veins, and give rise to no symptoms until they have extended to the vena cava. They may be present before operation, hence great care should be observed in operating upon patients with evidences of venous obstruction, especially if the heart-action is weak, since even perfect asepsis does not guarantee recovery.

Mahler,[1] in an article on the same subject, reports fourteen fatal cases of pulmonary embolism occurring in the Dresden clinic between 1884 and 1894, six after gynecological operations. In every case brown atrophy or fatty degeneration of the heart was also found (as in the nine cases reported by Hoffmeier). He calls attention to the fact that when a large neoplasm is removed the intra-abdominal pressure sinks and the pelvic veins become dilated. Three varieties of thrombus formation are to be distinguished, viz.: The thrombus may extend from the uterus or its immediate vicinity into the pelvic veins; it may originate in the crural vein and extend

[1] Arbeiten aus der königlichen Frauenklinik in Dresden, 1895, Band ii.

upward into the iliac; it may form in the dilated veins of the broad ligaments, which are flabby, thin-walled, and cannot contract, so that the circulation is retarded. Moreover, the veins may be compressed by plastic exudate. The surface left after the enucleation of a fibromyoma is analogous to the placental site. Old thrombi may be present at the time of operation. Schwanz reports two fatal cases of embolism due to the detachment of such thrombi, and Dohrn[1] one in a case of fibroid before operation. (I recall a similar case at the Woman's Hospital, in the service of Dr. Thomas.) Such thrombi are not infrequently present in the veins of the thickened broad ligament, in connection with inflammatory disease of the adnexa or twisted pedicles, and extend into the pampiniform plexus after operation. After hysterectomy thrombi may form in these plexuses and in the utero-vaginal veins on both sides. The capillary system of the broad ligament is such that the collateral circulation is established slowly.

In conclusion, this writer also calls attention to the more serious significance of intra-pelvic as compared with crural thrombosis, since in the crural veins the thrombi tend to become organized, while in the pelvic veins, which are without valves, the clot may extend up into the iliacs, whence emboli may be carried directly to the lungs. In regard to crural thrombosis, he adds the caution that the absence of edema is no indication that serious trouble is not present.

A recent contribution to the subject of thrombosis and embolism by Singer[2] deals more particularly with peculiarities of the pulse-curve, especially in fatal cases. Although his conclusions are based on observation of the phenomena attending puerperal thrombosis, they are applicable to some extent to post-operative cases. He distinguishes simple and inflammatory thrombi; the latter may be due purely to gonococcus-infection, as shown by bacteriologic examination, in

[1] Zeitschrift für Geb. u. Gyn., Band xi.
[2] Archiv für Gynäkologie, 1898, Band lvi. p. 218.

which case the condition is not true puerperal phlegmasia. Singer evidently does not subscribe to the view that all thrombi are of septic origin.

It must be confessed that a careful review of the literature has failed to establish the etiology of post-operative thrombosis, especially with regard to the important question of septic infection.

For information on this obscure subject I naturally sought the fountain-head, and addressed a letter to Professor William H. Welch, who, in the kind and helpful spirit which always marks his attitude toward his younger brethren, replied at considerable length to my queries. I take the liberty of quoting several sentences from his letter:

"My Dear Doctor Coe: Femoral thrombosis, or phlebitis occurring under the conditions which you describe, is a very interesting subject, but I do not think that the underlying causation is understood. I am familiar with this class of cases, as several similar instances have been observed here, particularly after gynecological operations, but also after other surgical operations on the abdomen, as for the radical cure of hernia, and, indeed, after surgical operations in general. In most cases there was nothing to raise suspicion of any septic or infective condition before the onset of the thrombosis, and then nothing but the thrombosis. In at least one instance the thrombosis involved the veins of an upper extremity. I do not know how well founded may be the impression which I have seen expressed that this complication is more common now than formerly.

"Of late years some writers, particularly of the French school (Cornil, Widal, Vaquez), consider practically all venous thromboses, including those formerly called marantic, as infective, and it is true that bacteria have often been detected in these thrombi. Still, there are not a few negative results in examining the same class of cases, and I think that it is going altogether too far to generalize on the obser-

vations thus far collected, and to assume that all these plugs are due to infection. Some have thought that the frequent onset with chills, elevated temperature, and rapid pulse indicated positive infection; but while, of course, suggestive of such an interpretation, I do not think that these symptoms are conclusive upon this point.

"We have been examining bacteriologically this winter all of the thromboses found at autopsy, and while several, perhaps the majority, have contained bacteria, oftenest streptococci, others have been sterile, so that I am not convinced of the infective origin of all such cases as you describe. Take the thromboses complicating chlorosis; these are often severe, with chills, high temperature, etc., and still thus far (with one very unconvincing exception) their bacteriologic examination has been negative.

"But I do not think that we can at present exclude infection in all these cases as the cause, and if we reject this explanation we should be quite at a loss for any other explanation. I am, therefore, inclined to the hypothesis that your cases and similar ones are due to infection, but at present this is only a hypothesis, and its foundation is mainly the difficulty of assigning any other probable cause. What is needed is an anatomic and bacteriologic examination of the thrombi in these cases, and as the termination is usually favorable, the opportunities for such examinations are necessarily rare.

"This is all very unsatisfactory I know, but the whole field is one which needs cultivating before any definite conclusions are warranted."

[Dr. Welch's article on thrombosis, in the recently published volume of Allbutt's *System of Medicine*, contains an interesting summary of existing views on this subject, with copious references.]

The following cases occurred in my practice between May, 1898, and May, 1899:

CASE I.—(Private.) Multipara, aged thirty-five years, with excellent general health, but with a history of recurrent attacks of peritonitis and constant abdominal pain. Diagnosis: Laceration of the pelvic floor, retroflexion with adhesions, diseased adnexa. Operation May 19, 1898. Divulsion and curettement, colpoperineorrhaphy, followed by removal of both adnexa and the adherent and diseased appendix and internal shortening of the round ligaments. Adhesions slight, and no raw surfaces left within the pelvis. Separate ligation of the ovarian arteries, excision of the tubes, and suture of the broad ligaments in the usual manner, so that no stumps were left. Catgut used throughout. Convalescence normal, the highest temperature being 100.2° F. on the first day after operation. The patient began to complain of pain along the course of the left femoral vein at the middle of the second week. Well-marked induration was felt in the usual locality just below the groin, with slight edema of the foot and ankle. Pulse below 100, and temperature 99.5° to 100° F. No constitutional disturbance. Pelvic examination negative. Primary union of the wound.

The patient was kept absolutely quiet, but during my absence from the city for a day (on the twenty-fourth day) she insisted on being transferred to her home, which was only a short distance from the hospital, where she remained in bed for two weeks longer. Stiffness and edema persisted for two or three months, so that she was obliged to wear an elastic bandage, but she eventually made a perfect recovery, and has since led an active life, taking long bicycle rides, etc.

CASE II.—(Private.) Multipara, in good general health, aged thirty years. Sterile after six years of married life, suffering from severe dysmenorrhea and persistent pain in the right ovarian and appendicial regions. Diagnosis: Anteflexion with stenosis, disease of the right ovary and tube, and possibly of the appendix. Operation July 1, 1898. After divulsion and curettement the abdomen was opened and the right ovary and tube were removed, with the thickened and adherent appendix. Ligation with catgut, no stump being left. Left ovary and tube entirely normal. During the night following the operation (the weather being intensely hot) the temperature rose to 103° F., but

without acceleration of the pulse or indications of local trouble. During the week which followed the thermometer was seldom below 90° F. in her bedroom, and she suffered greatly from the heat, in spite of ice-bags and cold sponging. Her temperature was irregular, ranging from 101° to 102.5°, but without any evidence of sepsis, so that no alarm was felt with regard to her ultimate recovery. On the fifth day she began to complain of pain in the left leg; a day or two later tenderness in the left groin on deep pressure was noted. By vaginal palpation a small, sensitive induration was detected at the base of the left broad ligament. The temperature declined steadily after the first week, and soon dropped to 100°, while there was at no time any marked acceleration of the pulse (it was seldom above 100) or constitutional symptoms.

The thrombophlebitis was quite obstinate, pain persisting for two weeks, though the edema was never well marked. The pelvic induration could not be felt after the second week. Primary union of wound. She left for the country five weeks after the operation, wearing an elastic bandage, but did not make a complete recovery until fall, when she reported in excellent condition. I heard through her physician, six months after the operation, that she was entirely relieved of her former pains.

I have never been able to assign a satisfactory explanation for the sudden elevation of temperature. Insolation was suggested as a possible cause. Fever developed too early for local sepsis, and was too persistent for ordinary traumatic reaction. The patient was exceedingly nervous and restless, but I have never admitted "nervousness" as a cause of fever after surgical operations.

Case III.—(Private.) Multipara, aged thirty-two years, general health good. Pressure-symptoms, dysmenorrhea, and menorrhagia, and more or less constant pain in the right inguinal region. Diagnosis: Small ovarian cyst. Operation November 3, 1898. Curettement, followed by removal of a cystoma of the left ovary, the size of an orange, non-adherent. Right ovary and tube normal. Catgut ligatures, and no stump. Appendix, the size of the thumb, removed and found to contain

concretions, with marked thickening of its walls. Convalescence afebrile until the tenth day, when the patient began to complain of pain in the left leg. The temperature rose to 100° F., and fluctuated between 100° and 101.5° during the next ten days, the pulse seldom exceeding 100. Pain and induration along the left crural vein, but at no time was there any edema of the foot and ankle, merely a slight increase in the measurement at the calf. Vaginal examination negative. Constitutional disturbance limited to headache, coated tongue, diarrhea, and sleeplessness. Primary union of wound. The family physician came to the conclusion that the patient had developed a mild case of typhoid, which I doubted. The temperature became normal after three weeks, and she went home during the fifth, wearing a bandage. She remained in bed for a fortnight longer, and called to see me two months after the operation, feeling quite well, with the exception of some stiffness of the leg, which prevented her from walking more than two or three blocks at a time. This soon disappeared, and she has since been in good condition.

Case IV.—(Hospital.) Virgin, aged forty years, a dressmaker, who had always enjoyed good health. She had a large ovarian cyst, which had undoubtedly existed for eighteen years (!), without giving rise to marked symptoms until within the past year. Operation March 4, 1899. Dermoid cyst, springing from the left ovary, entirely without adhesions, although it filled the abdomen. Right ovary and tube normal. Catgut ligatures, with suture of the broad ligament in the usual manner. Temperature reached 100° F. only once, on the third day; pulse never above 90. Toward the end of the second week she began to complain of pain along the course of the left femoral vein. Moderate edema of the foot and ankle. Vaginal examination negative. No constitutional disturbance. Primary union of wound. The symptoms rapidly subsided, and the patient insisted on leaving on the twenty-sixth day against advice. She remained quiet for two or three weeks, and made a perfect recovery. I saw her on May 15th, when she had no remains of the trouble, except slight stiffness in the affected limb, which did not interfere with locomotion.

CASE V.—(Private.) Multipara, aged forty-five years, strong and well-nourished. Had suffered for several months with menorrhagia, pain in the lower abdomen, and pressure-symptoms. A fluctuating tumor the size of a grape-fruit was felt to the right of and anterior to the uterus, the organ being enlarged to three or four times its normal size. Diagnosis: Ovarian cyst.

Operation March 23, 1899. Divulsion and curettement, a small fibromyxomatous polypus and a quantity of fungosities being removed. Non-adherent cystoma removed from the right side and a commencing cystoma of the left ovary. No evidence of fibroid growths. Catgut ligatures, and no stumps left.

Convalescence entirely afebrile until the tenth day, when, after a slight chill, the temperature rose to 100° F. and the patient began to have pain at the origin of the saphenous vein. The pain was more severe than in either of the previous cases, and was persistent, being only relieved by the constant use of an ice-bag (which I have found is the best local application in this condition), but the temperature only once reached 102.5° in the evening, dropping to 99° in the morning. The pulse at no time exceeded 100, the average rate being 80, even when the temperature was elevated. Marked induration along the saphenous vein, with considerable edema of the thigh, but none below the knee. Mild constitutional disturbance. Vaginal examination showed a distinct, painful induration at the site of the stump, which could be traced outward to the pelvic wall. This disappeared in a few days with the use of hot douches (as in Case II), while the crural phlegmasia was at its height. Convalescence was tedious, but the patient's general condition was excellent; she took plenty of nourishment, slept well, and preserved her usual equanimity. The temperature declined to normal at the end of the fourth week, when she was allowed to move to the lounge. As the pain returned (without rise of temperature) she was kept in bed for another week, and was not able to walk about her room until six weeks had elapsed after the operation. She went to church a week later, and is now (exactly two months after the operation) in excellent condition.

Just after writing the foregoing my attention was called to a sixth case, which seems to belong under this category.

CASE VI.—(Private.) Primipara, aged twenty-one years, married one year, a well-nourished German, whom I saw for the first time April 6, 1899. She was delivered at term three days before. Labor had proceeded normally for twelve hours, when the head was arrested at the perineum, the pains becoming inefficient. The attending physician administered two drachms of ergot, soon after which the child was suddenly expelled with a violent pain; a half minute later a second violent contraction occurred, completely inverting the uterus. The placenta was implanted centrally at the fundus, the cord being unusually short. The doctor peeled it off and attempted to replace the uterus, which was impossible, on account of the firm contraction of the ring. The hemorrhage was profuse, the patient collapsed, became pulseless, and was only kept alive by saline enemata and hypodermatic stimulation. Twelve hours later her pulse was 180, and the following day it remained at 150, and was quite feeble. Forty-eight hours after the accident an attempt at reduction was made under anesthesia, but she again collapsed, so that the manipulation was continued for only a few minutes. She was transferred to my service in the General Memorial Hospital seventy-two hours after the accident, having a pulse of 130 and a temperature of 101° F., exsanguinated, with unmistakable evidences of sepsis. Under light anesthesia the diagnosis of complete inversion was confirmed, but no attempt was made at reduction, on account of the necrotic condition of the endometrium and the patient's extreme weakness. Decomposed membranes and bits of placenta were removed, douches of pure peroxide of hydrogen and saline solution were given and the vagina was tamponed.

During the next two weeks the temperature ranged from 99° to 101.6° F., the pulse varying from 90 to 120. Douches of peroxide and saturated solution of boric acid were used, at first every six hours, later twice daily. The patient improved rapidly, her recovery being retarded by several ugly abscesses on the arms and legs (a legacy of the accoucheur). She sat up on the twenty-third day, and menstruated normally two days later without discomfort, normal involution having occurred. On the thirty-second day after entering the hospital (the thirty-fifth since the accident) she was in a good condition for operation.

Under anesthesia it was at once evident that reduction could not be effected by ordinary manipulation. Although the uterus was small (about the size of a Bartlett pear) the contraction ring was unusually tight. The abdomen was opened, and with the able assistance of Dr. Jarman, after half an hour of hard work, the ring was stretched with the fingers and a Wathen's dilator (the ends of which were guarded with rubber tubing), and we succeeded in replacing the inverted organ. The tubes, ovaries, and broad ligaments were perfectly normal, and there was no evidence of any obstruction to the circulation. As the round ligaments were greatly elongated, it was deemed advisable to shorten them by Mann's method. No reaction after the operation. Temperature on the following day was 99.4° F., and after the fourth day 98° to 99°, the pulse ranging from 80 to 90. Convalescence entirely normal up to the ninth day, when examination of the wound showed primary union. The same evening the temperature rose to 100.2° F., the pulse being 90, and the patient complained of pain in the left groin and inner aspect of the thigh. It appeared later that she had felt slight pain on the previous day, but had not alluded to it. Examination *per vaginam* on the following day revealed a tender cord, which could be traced from the side of the uterus along the base of the broad ligament to the pelvic wall, where it was evidently continuous, with an induration at the beginning of the saphenous vein. Uterus small, in normal position, and insensitive. No vaginal discharge; no edema of the limb. The evening temperature was 101° F., the pulse 92. No constitutional symptoms. On the eleventh day the temperature ranged from 100.4° to 102.2°, the pulse being 112. Pain moderate, and slight edema of the foot noted. On the twelfth day temperature 100.4° to 102° F., pulse 106 to 112. Treatment: Hot vaginal douches, ice-bag, elevation of the limb, strychnine and quinine. Patient taking plenty of nourishment, and presents no septic symptoms.

On the following day her temperature fell to 99°, the pain and edema rapidly disappeared, and she was discharged, at her urgent request, in the fourth week, without any trace of local trouble. The pelvic organs were entirely normal. I heard two weeks later that she was in excellent condition.

I have few comments to add to these clinical notes. A rigid revision of the technique, both by my associate, Dr. George W. Jarman, and myself failed to reveal any loophole by which infection could have crept in. Dr. Jarman himself assisted me in four of the private operations and personally attended to the sterilization of the instruments and field of operation. The nurse was not allowed to touch anything that came in contact with the wound. According to our usual custom, after thorough sterilization of the hands by the method employed at the Johns Hopkins Hospital, rubber gloves were worn, which were removed immediately before the operation, when the hands were again washed in alcohol, bichloride 1 : 1000, and saline solution. Neither of us had recently attended a septic case. The catgut, prepared by Levens, was regarded as above suspicion, and the tubes were sterilized with the instruments. In short, as the cases were important ones, every precaution was taken to ensure a perfect result. The disappointment at the failures was therefore so much the keener.

Certain negative points should be emphasized. No foci of infection were discovered during the operation. Mass-ligatures were not used, no stumps were left at the uterine end, and no raw surfaces remained within the pelvis, yet in three cases there was evidently thrombophlebitis of the veins in the broad ligament of the affected side, which, presumably, was continuous with the process in the crural vein. Curiously enough, in Case II there had been no lesion of the tissues on the left side, as the tube and ovary were normal. The pelvic indurations disappeared within a week, while the crural thrombosis was at its height, leaving absolutely no trace, such as often persist for months in the case of inflammatory exudates surrounding silk ligatures and infected stumps. The patients were all in excellent general condition before and after the operation, with no evidence of circulatory disturbance, so that the theory of marantic thrombosis is untenable. No traces of varicosities of the veins of the ex-

tremities or of those within the pelvis were noted. The bowels were moved daily after the third day in each instance. In none was there any disturbance of the stomach, or any symptoms causing anxiety with regard to the ultimate recovery of the patient. Pain in the affected limb was the most marked symptom, and in all but one case it was sufficient to constitute a true phlegmasia dolens. Induration was present in all, but the edema was moderate, localized, and transient, leading to the inference that either the thrombi were parietal or that the collateral circulation was free. Recovery was rapid as compared with ordinary cases, even though the mistake was made of allowing the patients to leave their beds too soon. In but one instance did a chill occur, and in only two was there the acceleration of the pulse, on which Singer and others lay much stress. In short, the clinical histories throw little or no light upon the etiology of the condition. Certainly, the occurrence of six cases of this character within a year in the comparatively limited experience of a single operator must be regarded as unusual, if not unique.

It is interesting to note that the appendix was removed in three cases. Attention has been called by Welch to the fact that left crural thrombosis has been noted in several instances as a complication of this operation.

In this connection I may be permitted to refer briefly to a case of crural thrombosis following trachelorrhaphy—a rare complication after this simple operation, considering the number of times that it has been performed and the septic infection (sometimes fatal) which used to attend it in the early pre-aseptic days. Why it should be so infrequent I do not know—in fact, I have never met with any allusion to it in the voluminous literature of Emmet's operation.

The patient (private) was a delicate subject, aged twenty-five years, whose only labor had been rather severe, terminated by forceps. Bilateral laceration of the cervix, with fixation of the uterus, due to a large cicatrix extending to the base of the left

broad ligament; laceration of the pelvic floor. Operation January 6, 1898. Strict aseptic precautions were observed, as in vaginal hysterectomy. Curettement, bilateral denudation of the cervix, the cicatrix on the left side being dissected out. Chromicized gut sutures. Hegar's colpoperineorrhaphy, with a continuous suture of chromicized gut within the vagina and a few external sutures of silkworm-gut. Convalescence afebrile, and the patient was kept absolutely quiet for two weeks. Toward the end of the second week she complained of some stiffness in the left leg, but had no rise of temperature above 99.5° F. A well-marked thrombophlebitis developed, with considerable pain and edema. There was tenderness on palpation in the left lateral fornix, but no induration could be felt. Primary union of perineal and vaginal wounds. The patient suffered from pain and edema for several weeks after the operation, and could not walk without a bandage. Examination of the cervix at the end of a month showed excellent union, and nothing abnormal could be detected in the pelvis. It was at least six months before she experienced the benefit of the operation, and her example naturally deterred some of her friends from running the risk of a similar experience at my hands.

In the absence of any evidence of sepsis, and considering the anemic condition of the patient, I was inclined to believe that this was possibly a case of so-called anemic thrombosis, with which the operation had nothing directly to do. This view, however, is open to criticism.

The question of most practical interest in connection with this subject is that of prophylaxis. Is it possible to foresee and to prevent thrombosis after celiotomy? Judging from the cases which I have reported, we are not yet in a position to give an affirmative reply. Wyder and Mahler advise not to operate upon patients with weak hearts; varicosities and edema of the lower limbs savor rather of post hoc reasoning derived from observations in the dead-house. All surgeons operate under these conditions, and yet the number of cases of thrombosis and embolism are insignificant consider-

ing the number of operations. Wyder's inference, that the frequency of this complication must increase with the constant increase in surgical activity, is hardly borne out by the facts. Certainly, the mortality after celiotomy in the foremost foreign and American clinics has steadily decreased with the perfection of modern aseptic technique. Improved methods of operating and greater experience and manual dexterity have reduced the actual period of anesthesia, and with it the number of deaths from shock, hemorrhage, and visceral complications. Sepsis is, and always will be, the one enemy which we have to fear. When we have succeeded in banishing it, at least from without, will thrombophlebitis be also eliminated in cases which were aseptic before operation?

The diagnosis of thrombosis confined to the pelvic veins, as shown by Wyder's cases, is practically impossible; but when combined with the crural variety (as in three of my own cases), it may be inferred from the presence of an induration extending along the broad ligament of the affected side. The recognition of crural phlegmasia after it has fully developed is so easy that even a tyro would not overlook it; but it has been affirmed that an expert should recognize the latent symptoms which appear in what Vaquez calls the "pre-obliterating" stage.[1] Singer,[2] who has devoted considerable attention to a study of the pulse, claims that it is always more rapid than usual from the outset (that is, after the disturbance attending the operation should have subsided); and that after the seventh day the curve rises sharply, reaching its acme on the ninth day, when the local signs of obstruction appear, there being a direct relation between the pulse and the gradual development of thrombosis, with the consequent increased resistance to the circulation. In a typical case the curve rises rapidly, while the temperature is still normal, and remains high after the latter drops. This peculiarity of the pulse (designated as *staffelförmiger* or *treppenpuls*) is regarded

[1] L'Abeille Medicale, 1896, No. 53, p. 281. [2] Loc. cit.

by all recent observers as the most important, in fact, the only early indication of beginning thrombosis. It was most characteristic in the fatal cases of pulmonary embolism, so that its persistence and accentuation are regarded as somewhat ominous. Since it was not marked in my cases, I infer that they belong to a different type from those on which Singer based his conclusions—in fact, the phenomenon seems to be most marked in puerperal phlegmasia. It would seem to point to a septic condition, in the diagnosis of which it is well known that the pulse is often of more value than the temperature.

So far as my own experience has gone, a slight elevation of temperature (99.5° or 100°) is most apt to attract the attention of the ordinary observer, and, in the absence of evidences of trouble in the wound or within the pelvis, to lead to the suspicion that phlebitis is developing; but careful questioning of the patient will often elicit the information that slight stiffness of the leg was noted before any other symptoms (especially pain) appeared.

The pain is often entirely out of proportion to the extent of the lesion. I do not know that it has ever been satisfactorily explained, unless we accept Simpson's view, that it is caused by stretching of the walls of the vessel. The early notion that it was due to an accompanying peripheral neuritis he positively rejected, though it is now held by careful observers.

Edema is nearly always present, though it may be so slight as to be appreciated only on careful measurements of both limbs. In this respect my cases presented a marked contrast to the phlegmasia attending puerperal and post-operative septicemia.

The prognosis in the class of cases which I have described is favorable as regards both a rapid recovery and complete disappearance of the local trouble; but the experience of the German surgeons whom I have quoted serves to emphasize in quite a startling way the fact that thrombosis following

aseptic celiotomy is a complication which cannot be regarded with indifference. The sudden onset of pulmonary embolism in patients whose condition had not previously caused the slightest anxiety furnishes a forcible commentary on the uncertainty of the prognosis, as well as the absolute helplessness of the surgeon.

In regard to treatment, it cannot be said that the usual local applications or general medication influence the course of the affection, either by limiting the extent of the thrombus or by hastening its resolution. Absolute rest in the recumbent posture without manipulation of the affected limb, although irksome to the patient, is the most important point. We are apt to yield to her importunities and to allow her to sit up too soon. The disappearance of the local pain, induration, and edema, and the continuance of a normal temperature for several days, are usually regarded as indicative of complete recovery; but as long as the pulse remains at 90 or 100 it is well to err on the safe side and to keep the patient in bed for a few days longer. Singer even insists that the recumbent posture should be maintained for at least three weeks after the pulse has become normal. Altbough this caution may seem to be extreme, it will at least prevent a relapse, with the consequent annoyance to the patient, even though the risk of pulmonary embolism may be so slight as to be disregarded.

DISCUSSION.

Dr. Thomas Addis Emmet, of New York.—Is not this condition due to too much traction?

Dr. Howard A. Kelly, of Baltimore.—This is an important and timely subject of immense practical interest. There can be no doubt that thrombosis may occur after the simplest as well as after the gravest operations. Whether this is due to infection or not I cannot say, but I should think not, judging from the class of cases in which I have seen it. A patient who

is apparently making a good recovery may, on the tenth or twelfth day, fall over, gasping for breath and drop dead; or, in another type, suffer from a distressing attack of palpitation of the heart, recover from that, and die after a succession of such seizures, or, perhaps, finally recover after several attacks. Thrombosis presents itself in three different parts of the body. First, and most common, is crural thrombosis. When it is well marked no description is necessary in order to recognize it. There are high temperature, rapid pulse, and localized tenderness and swelling of the thigh. When the latter is not well marked comparison and measurement of the two thighs will guide one in making the diagnosis. There will be a definite difference in the size of the two limbs which may increase at a later stage.

Pelvic thrombosis is next in order as regards frequency. This form is very apt to produce embolism and death. I am in the habit of suspecting thrombosis in the pelvis when there is a slight rise of temperature accompanied by some acceleration of pulse and some local tenderness, or in cases in which the patient simply complains of a fixed pain upon one side after operation; here the subsequent history usually shows that the case went on to a well-formed pelvic or crural thrombosis.

There is a third and rare form of thrombosis which I do not think the author mentioned, and that is the axillary thrombosis. I have seen two such cases, one of which is still in my private hospital. The trouble came on during the fourth week, after a suspension operation and without marked elevation of pulse or temperature, the diagnosis being made from the difference in the size of the two arms. The other case was one in which one of my assistants operated at the Johns Hopkins Hospital, removing two large necrotic ovaries. The left arm became enormously swollen, and but for the fact that we know that gangrene rarely sets in, we should have expected to amputate that arm. The patient was kept quiet, and recovered.

These patients should be treated with great care and cautioned not to get up or to exercise. I know of a patient who, some weeks after a vaginal hysterectomy, dropped dead while rising from bed. This patient, however, had manifested some definite cardiac symptoms before operation. About six years ago I lost a patient who was apparently making a perfect

recovery after removal of papillomatous ovaries. She dropped dead on the eleventh day.

Dr. Willis E. Ford, of Utica, N. Y.—Last week I lost a patient from embolism after a simple operation—removal of what I thought was sarcoma of the round ligament, but which proved to be only fibroma of the round ligament, situated in the right labium. I noticed that the vein under the ligament was rather large, and I included it in the ligature, and did not open the inguinal canal. The woman did well and did not have temperature, but on the eighth day she suddenly expired after having a movement of the bowels. There were evidences of pulmonary embolism, though no autopsy could be obtained. A near relative of hers died last year after an operation. Four or five years ago I did a laparotomy upon a woman who, eight weeks later, suddenly expired, also after a movement of the bowels. In this case death was preceded by pain, which was first referred to the eye-tooth and then to the chest. Death occurred in both instances within half an hour from the first symptom. In another case since my last death, a woman who had recovered from a simple abdominal operation suddenly collapsed, her heart became feeble and rapid, and she gasped for breath like the other two cases. She did not die, but afterward she was found to have a myocarditis and some roughening of the valves, though this was not observed at the time of the operation —four weeks before. She had at one time—two years before—been thoroughly septic. It has occurred to me that many of these cases of sudden death may have had a myocarditis.

Dr. A. Palmer Dudley, of New York.—I want to report the history of a case which is of interest. The patient was in my private hospital, and had had a tumor and the tubes and ovaries removed. It was not at all a bad case. Soon after she was seized with an intense pain in her heart. We stimulated her and she became somewhat better, but during the night she had another attack and died, showing every evidence of thrombosis.

Dr. Emmet has asked whether undue traction is not the cause of this condition. I believe that it is; also, that it is caused by the pressure of forceps upon the pampiniform plexus of the broad ligament, causing the formation of a small clot, which is taken up by the circulation when the latter is resumed after having

been obstructed. In my case I think that I was directly responsible for causing that woman's death, because I placed the forceps upon the broad ligament while I removed the fibroid. In many of these cases we are obliged to make considerable traction. We carefully place forceps on the soft tissues, bloodvessels covered by peritoneum, and in this way partial paralysis of the vessel and the formation of clot are caused, and embolism follows.

Dr. Henry D. Fry, of Washington.—I was unfortunate enough to lose a case of hysterectomy from embolism during the second week of convalescence. The patient was doing well, had had no fever, and was talking and laughing a few minutes before death. I would ask if axillary embolism may result from the cramped position of the patient's arms when tied by the hands above the head at the time of operation? A few months ago this was the cause of paralysis of the left arm following a hysterectomy. The hands had been pinned by the sleeves above the head, and the clothing had constricted the nerve-trunks in the axilla. The paralysis passed away after about six weeks.

Dr. Hunter Robb, of Cleveland.—The cases mentioned by Dr. Coe in his extremely interesting paper must be classed among the unavoidable accidents. Undoubtedly, in many cases sudden deaths are usually due to thrombosis, but in rare instances some other cause may have existed which is only discoverable if the patient comes to autopsy. A case which occurred lately in my own hospital service is of interest in this connection, since infection was excluded, and had it not been for a careful autopsy death would undoubtedly have been attributed to thrombosis.

The patient was a married woman who was suffering from prolapsus of the uterus. A vaginal hysterectomy was resorted to, and she was practically convalescent on the seventeenth day after the operation. On this day, however, she died quite suddenly. At the autopsy a cyst was discovered at the base of the brain, between the pia arachnoid and brain substance, and in direct connection with the fourth ventricle, and thus with the various fluid-containing cavities of the brain. In this case, then, we had to deal with a congenital cyst of the brain, which, after remaining innocuous for over thirty years, produced sudden death without any apparently exciting cause.

Dr. George Tucker Harrison, of New York.—I wish to report a case of crural thrombosis following laparomyomectomy, in which I had the valuable assistance of Dr. Palmer Dudley when I operated. The patient was a middle-aged single woman, and the operation, as far as I know, was absolutely aseptic. Three or four weeks later crural thrombosis supervened, and I am not willing to admit that sepsis was the cause. Dr. Welch leaves this an open question, according to the letter he wrote to Dr. Coe, and we always listen with the highest respect to anything from him in regard to pathologic points. Reasoning from analogy, we might assume that thrombosis came from weakness of the general circulation. The patient had a very weak heart. In another case a patient who was suffering from pulmonary tuberculosis stumbled and fell, and this was followed by crural thrombosis. It was certainly not of septic origin in this case. In the case just mentioned the patient had apparently recovered, and got up and took a little exercise. A small clot was carried into the circulation, and embolic pneumonia was caused, from which the patient died. I have also seen crural thrombosis follow childbirth. In a case of mine the patient was able to be up and about, and had gone down stairs for the first time. Upon coming up stairs she was suddenly seized with pain in the leg, caused by crural thrombosis. Here also sepsis may be excluded. I regard these as cases of marantic thrombosis.

Dr. Reuben Peterson, of Chicago.—My experience leads me to differ from the majority of the speakers. I do not regard this condition as being due to pressure of forceps or to our manipulations, but rather to sepsis. For the past five or six years I have been doing total hysterectomy.

Formerly I used silk in tying off the pedicle, and I have had a certain number of cases in which fistula followed, as has been the experience of the majority of operators. Two years ago I substituted catgut, and since that time, although I have employed the same technique, I have had only two cases of thrombosis. In these two cases I know there was sepsis present, because I had a number of septic cases in the hospital at the time, and I attributed it to the catgut. I also think it may come from a weak heart, for I have seen two cases of sudden death immediately following operation. Autopsy showed embolism of the pulmonary artery. In cases in which the condi-

tion comes on some days or weeks after operation I am inclined to regard as due to sepsis.

DR. MALCOLM MCLEAN, of New York.—I would like to call attention to one point in the etiology of this condition, and that is the personal element or idiosyncrasy of the patient, which must not be looked upon too lightly. I have observed several cases in which the family history showed a tendency toward this condition. In one case the patient suffered from thrombosis on two different occasions, once after an operation and the second time after childbed. I had another case in which thrombosis occurred without any operation or lesion of the skin, and this might be called idiopathic thrombosis. Inquiry showed that in the family there existed this tendency.

DR. CHARLES P. NOBLE, of Philadelphia.—I think we are all of us inclined to believe that every inflammatory process is septic in character. This is the present trend, although there is a certain amount of difference of opinion. My experience leads me to doubt whether post-operative phlebitis is septic, because only in a single case out of perhaps thirty-five which I have seen could I be sure that there was sepsis present. In the one case the patient was clearly septic. I have had at least two cases of thrombosis following hysterorrhaphy, and as no forceps were used it cannot be said that it was due to pressure by forceps. I have also seen thrombosis follow Alexander's operation in two cases. My experience leads me to believe that pressure is not the cause of this condition. As to results, recovery followed in all the cases which I have seen, with one exception—a patient who died on the sixth or seventh day after a kidney operation. Unfortunately, no autopsy was obtained, and it is only assumed that thrombosis was the cause of death. Since then I lost a patient who presented similar symptoms, and autopsy showed that death was due to acute congestion of the lungs and not to embolism. The diagnosis cannot be made from the symptoms alone, and in cases of death, unless an embolism is found in the lungs by autopsy, the diagnosis is open to doubt.

DR. WILLIAM H. WATHEN, of Louisville.—I have had only one case in which death resulted from what appeared to be embolism of the lung. In this case I had done an exploratory celiotomy, wounding no structure except the abdominal wall, and making a very small incision. The wound was immediately

closed, for it was found that the trouble was malignant and out of reach of surgery. The patient had no trouble at all when she came from under the influence of ether. The pulse and temperature were normal, and the patient was cheerful and did not know she had been operated upon. She did well for five or six days, when, during the absence of her nurse, she turned over in bed unassisted, and in less than five minutes was dead.

DR. G. W. JARMAN, of New York.—It seems to me that there is one point which has been overlooked in discussing this subject. All of the speakers have cited practically the same class of cases to illustrate their remarks—bad and septic cases. But it is not in such cases that Dr. Coe has found thrombosis. On the contrary, it has been in clean, minor abdominal cases. Therefore, it would not seem possible that the condition is caused by sepsis. I have worked with Dr. Coe for so long that my footsteps follow in his. I operate as he operates, employ the same methods and the same technique, yet I have never had but one case of thrombosis. The case was a mild one, and was aseptic. The operation which had been performed was the removal of a fibroid per abdomen. If thrombosis is due to sepsis, why is it that we find the condition in the clean aseptic cases and not in the septic ones? It is for the future to find out what is the cause of thrombosis.

DR. H. N. VINEBERG, of New York.—I would like to refer briefly to a case which recently came under my observation. The patient had been operated upon for some slight ovarian trouble, and had also had appendicitis. On the ninth day, while eating her supper, she suddenly went into collapse. The attending physician feared there was a perforation of the appendix, and called in consultation a prominent surgeon. There was also a question of ptomaine-poisoning. Later, symptoms of consolidation of the lung developed. The patient had a pneumonic process which ran its course, and also a thrombosis of the leg. She recovered after some weeks. The patient was a very fat woman, and it was suggested that it was a fat embolism which had caused the trouble.

I would like very much to know if catgut was used in the operations in the cases reported by Dr. Coe, for the reason that in each thrombosis occurred about nine days after the operation, and it is well known that catgut will remain aseptic until it be-

gins to dissolve at about that time. The fact that so many cases occurred within so short a time would strengthen the suspicion that the catgut was at fault.

Dr. E. W. Cushing, of Boston.—I have never been able to find out the cause of thrombosis. My experience is that it does not occur in the severe cases as a rule. At times I have thought that I could connect the pressure upon the veins by subperitoneal fibroids with this condition. I do not think that sepsis has anything to do with it. Septic pyemia is entirely different. I would call attention to the fact that cases occur at the same time of the year in the practice of various surgeons who are widely separated.

Dr. Coe (in closing). —The point raised by Dr. T. A. Emmet, that thrombosis might be due to excessive traction upon the uterus, is worth bearing in mind. It has also occurred to me that perhaps the use of Trendelenburg's posture might account for some of these cases, owing to the fact that the venous circulation is interfered with when the patient is kept in that position during a long operation. It is my practice to lower the patient for a few minutes before closing the abdomen, in order to see if any fresh oozing follows.

In regard to catgut, that used in these cases was prepared by Levens, and was supposed to be absolutely sterile. However, one can never feel absolutely certain about gut.

I was surprised to learn that there were so many of these cases on record, and think that the subject is one well worthy of collective investigation, with a view to determine the etiology of the disease.