

## THROMBOSIS AND EMBOLISM FOLLOWING ABDOMINAL OPERATIONS.

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DR. KEITH, of Edinburgh, about fifteen years ago, when complimented on his splendid results in the removal of uterine and ovarian tumors, said: "My success would be greater still if it were not for peritonitis; it is peritonitis which beats us."

In those days it did beat us. In our improved surgical technique, nursing, and environments, we have very little fear of peritonitis in these days.

Lawson Tait remarked about the same time, when complimented on his marvellous success in 138 abdominal sections without a death, that "the last word had not yet been said about ovariectomy;" that "a certain mortality of about 2 per cent. would probably always attend these major operations, even in the best hands, due to accidents beyond the control of the surgeon, and about 1 per cent. would be due to unexpected malignancy, thus leaving 97 per cent. of recoveries when operated upon at the best time by the best men."

Thomas Addis Emmet has said: "It is the unexpected which most frequently happens in abdominal surgery."

Your attention will be briefly directed in this paper to one of the unexpected happenings, not exactly an accident, which unfortunately follows a certain small percentage of our abdominal operations, and which fortunately has more

to do with their morbidity than with their mortality. I refer to those cases of thrombosis, chiefly of the femoral vein, from which an embolus is occasionally detached, and which may, and sometimes does, cause a fatal pulmonary cardiac or cerebral embolism. These conditions are not, as a rule, preventable, while they are known to follow more frequently in the wake of supravaginal hysterectomies for the removal of uterine fibromas than in that of any other abdominal operation, with the possible exception of uterine suspension for the relief of retrodisplacement of the uterus. Femoral venous thrombosis may occur, however, during convalescence from perfectly aseptic minor gynecological operations, such as those upon the cervix uteri, vagina, or perineum, and they have been reported also as sequelæ of typhoid fever, pneumonia, and influenza.

All are, perhaps, very familiar with this complication from time immemorial, as it develops during the puerperium, and is described in text-books on obstetrics under the name of phlegmasia alba dolens.

At our Niagara Falls meeting last year, we had the pleasure of listening to a most elaborate and instructive paper on sudden death immediately after childbirth, or operations on the pelvic organs of women, by our distinguished fellow-colleague, Dr. E. P. Davis, of Philadelphia. The sudden deaths reported in this paper, and in the subsequent discussion which followed its reading, were caused mostly by immediate pulmonary embolism or heart-clot, while the cases to which I wish to call your attention are of postoperative femoral thrombophlebitis, occurring generally between the second and third week of a perfectly uneventful convalescence, as a rule, and following, so far as could be determined, perfectly aseptic operations upon patients for the most part free from septic infections at the time of the section.

According to Bosher, of Richmond, in his report of seven

cases of postoperative femoral thrombophlebitis, "if infection plays any part in the development of the lesion, this is seldom shown by other symptoms, for in most cases the wound heals aseptically, and the progress of the case prior to the appearance of the phlebitis is otherwise satisfactory."

Upon the causes as well as the condition itself, most of our modern text-books on gynecology and abdominal surgery are silent, Hirst being the only author who devotes any attention to this subject. He says femoral thrombophlebitis follows about 3 per cent. of abdominal sections, that it occurs usually in the left leg, and that its etiology is obscure. First symptoms are pain in the calf of the leg and in the groin, the leg rapidly swells, becomes milk-white in color, and pits on pressure. In addition to bandaging and covering the affected limb, he recommends an application of unguentum Credé, ichthyol and glycerin or analgesic balsam along the course of the femoral veins, and absolute quiet until recovery, so as to avoid the possible occurrence of a fatal cardiac or pulmonary embolism.

Kelly has drawn attention, in his book on appendicitis, to the occurrence of pleurisy and pneumonia during convalescence from appendectomy, and traces their causation to small emboli detached from femoral thromboses which occasionally follow this operation. He thinks we cannot give a positively favorable diagnosis in any abdominal operation until after the expiration of a month, on account of the possible and unexpected occurrence of femoral thrombosis from which a fatal pulmonary embolism may occur.

Davis, in the paper above referred to, gives as causes of pulmonary embolism producing sudden death after labor or pelvic operations, pre-existing infection, mechanical violence, altered conditions of the blood serum, and lesions of the walls of the bloodvessels.

The etiology, however, of the form of thrombosis under consideration does not appear to be settled. There are

two opinions held at present which are directly opposed to each other. As Boshier states it, according to the first the lesion starts as a phlebitis due to infection at the time of the operation, while the second theory regards thrombosis due to traumatism as the primary lesion, which, in turn, is responsible for the inflammation of the vein. Those who adopt thrombosis as the causative factor sustain their theory by reporting a series of operations in which a larger proportion of the perfectly aseptic cases had femoral thrombophlebitis than occurred in those previously infected.

Clark makes this contention, that injury to the epigastric veins by retractors, holding open abdominal incisions during protracted operations, is the cause of the trouble, and in proof draws attention to his forty-one cases, in which he insists that infection could not have been the cause, inasmuch as in his long series of cases septic operations were not as frequently followed by phlebitis as were the aseptic ones.

In my own series of eight cases, there was infection at the time of the operation in only one that was noticeable, at least by the usual symptoms, and no other characteristic evidence of the condition developed up to the time of the development of the thrombosis.

My own view of the causation in previously non-septic cases is partly that of Davis and partly that of Clark, namely, that the mechanical violence to the walls of the vessels which occurs at the site of the operation, and by the use of retractors, starts up an inflammatory process which gradually extends to the femoral vein, where thrombosis results in a certain unexplainable number of cases. Were traumatism the only cause one might expect postoperative femoral thrombophlebitis in nearly all cases of difficult pelvic surgery. Were a pre-existing infection the chief cause, or infection introduced by the surgeon at the time of the operation, one might naturally expect phlebitis to follow in nearly all

our septic cases. But it has been shown by Clark and others that exactly the opposite conditions most frequently prevail.

This is so often the case, that Cordier and others have given as the title of their papers on this subject, "Non-septic Thrombophlebitis" and "Thrombophlebitis following Aseptic Operations;" "Aseptic Postoperative Femoral Thrombophlebitis," etc. That infection plays a certain role in the causation of some cases of femoral thrombosis is evident by their occurrence during typhoid fever, influenza, and other infectious diseases, such as pneumonia: and postpartum infections. Steiner has reported forty-four cases of femoral thrombosis following pneumonia. The curious fact seems to be, that in a large proportion of these cases, no matter what the cause may be, the left leg is the one most frequently affected.

The anatomical theory insisted on by Clark and supported by Welch and Recklinghausen suggests a very plausible explanation. The epigastric veins so frequently mechanically interfered with by the retractors in use during most abdominal sections enter the femoral vein at an obtuse angle to the blood-current, thus giving rise to an eddying motion of the blood, which Recklinghausen advances as a most favorable condition for the formation of a thrombosis. Welch regards Recklinghausen's theory as a "valuable contribution" to our knowledge of thrombosis, and both he and Clark explain the occurrence of femoral thrombosis on the left side more frequently than on the right as being due to the more difficult return flow from the former, in consequence of the greater length of the left common iliac vein, its passage beneath the right common iliac artery, and probably to pressure upon this vein by a distended sigmoid flexure of the rectum.

This same causative influence seems to operate in those cases in which femoral venous thrombosis occurs in the

course of the acute infections above mentioned, inasmuch as we find it nearly always developing in the left leg.

As the great majority of these patients recover, and as great difficulty has been experienced in procuring autopsies in those rare instances where death has taken place suddenly from the occurrence of pulmonary embolism in the course of the malady, few opportunities are presented for a bacteriological examination of the thrombi. Welch, however, is quoted by Boshier as directing attention to the fact that even the finding of bacteria in the thrombus would not necessarily prove its infectious origin, since this might well be due to an invasion of the tissues during the time immediately preceding death, as pointed out by Flexner in his article on terminal infections. At present we seem scarcely able to state definitely the causative influences which bring about these cases of postoperative femoral thrombophlebitis. That they appear more frequently after operations in the female pelvis than after operations in any other part of the body, is a fact on which modern writers on this subject generally agree.

Dearborn, in an exhaustive article in the *Annals of Gynecology and Pediatrics* for November, 1904, reviewed the work of twenty-five surgeons of Boston, in which this fact stood out very prominently, and he further states that it is quite possible that many cases of pleurisy, pneumonia, and pulmonary abscess following abdominal operations are due to emboli.

Dr. G. Brown Miller has recently published a paper on embolic pleurisy following these operations. The condition of the blood after severe hemorrhages, either before the operation for uterine fibroids or malignant disease, or at the time of their removal, undoubtedly has something to do in favoring the formation of both pulmonary and femoral thrombosis and embolism. Agnew and others have stated that "after operations in which much blood

has been lost there is always more or less tendency to the formation of coagula," but this condition, I suspect, applies more directly to pulmonary than to femoral thrombosis, as in the latter condition a considerable loss of blood is not generally held to have any marked causative relationship. Dr. Wilmer Krusen, in a paper in the April number of the *American Journal of Obstetrics*, reported and collected thirty-two cases of pulmonary embolism, twenty-two of which were rapidly fatal, following abdominal and pelvic operations.

Writers generally agree that there is little or nothing, so far, definitely known, or evident at the time of the operation, to lead to any suspicion that thrombosis or embolism is likely to occur in any given case; a considerable loss of blood is supposed to favor the coagulation of that remaining in the vessels, and should put us on our guard both as to management and prognosis.

While fatal pulmonary embolism occurs, as a rule, much earlier than femoral thrombophlebitis, they both make their appearance without preliminary symptoms, and practically render it impossible for us to pronounce a patient free from danger until at least a month has elapsed, from any abdominal or pelvic operation, especially in women.

Thrombophlebitis rarely shows itself until after the end of the first week, and in some reported cases as late as the fourth week, and usually in the left leg. One of Boshers' cases occurred on the thirty-second day after operation, and in several after leaving the hospitals.

In Clark's cases this leg was affected twenty-five times, the right leg eleven times, and both legs five times. In cases where the operation has been on the right side, the left leg is the one usually thrombosed. This was noticed in four of Clark's cases.

In two cases reported by Willy Meyer, the left leg was affected, and upon its restoration the right became involved also.

In four cases reported by Vander Veer, the left leg *alone* was involved. In my own eight cases, the left leg was affected first in each instance, while in two the right was subsequently attacked.

In none did the trouble appear earlier than the second week, while in one fatal case after apparent recovery, while the patient was getting ready to leave the hospital, very sudden pulmonary embolism came on, and she died in a few moments after the onset of her first symptoms.

There is little to be said in regard to the diagnosis, prophylaxis, or treatment. Having its possible occurrence in mind after any abdominal or pelvic operation, we should find no difficulty in differentiating it from rheumatism, neuralgia, or any other complaint.

Increased aseptic precautions might lessen their possibility, on the theory of its infectious causation, and greater care in the use of retractors, protecting the soft parts by gauze pads under these instruments, might lessen the danger of traumatism to the epigastric veins, suggested by Clark.

Patients, especially those who had lost much blood or had been transfused, might be kept a longer time more quietly in bed, and the unobstructed and easy return venous circulation facilitated by the elevation of the foot of the bed immediately after operation.

The treatment, according to Boshier and others, is largely negative. Palpation is to be performed only when absolutely called for, and then with the greatest care, on account of the possibility of dislodging a portion of the thrombus, and thereby causing pulmonary embolism.

Complete rest in bed, elevation of the limb, enveloping the affected leg in cotton held in place by a lightly applied bandage, will usually result in complete recovery in two or three weeks without suppuration.

Some surgeons recommend the application of mercurial and belladonna ointments, but there is some doubt if the

manipulation required in use might not result in more harm than good.

The patient should not be allowed to make much muscular effort for some time after the complete subsidence of all local symptoms. The "wearing of an elastic stocking is recommended during convalescence, as likely to give support to the vessels and add to the comfort of the patient."

We have then, Mr. President, in postoperative femoral thrombophlebitis an unexpected and unpreventable complication to our abdominal and pelvic operations, which adds at least 3 per cent. to their morbidity. In pulmonary embolism, which seems to be equally unexpected and unpreventable, and which may in the late cases be a sequela of femoral thrombosis, we have an uncertain mortality to deal with, which, until we learn better how to prevent, will detract from our ability to prognosticate a cure, in the most simple aseptic cases even, for at least a month.

CASE I.—Mrs. W., white, aged thirty-five years, was operated on in October, 1890, for the removal of a large fibroid tumor of the uterus, by supravaginal hysterectomy. She did well for two weeks, when she began to complain of pain in the left groin and in the calf of the leg; the entire leg soon became swollen, the skin was tense and milk-white, and pitted on pressure. At first she was thought to have rheumatism. The femoral vein, upon examination, was found to be painful, hard, and the leg was colder than its fellow. A diagnosis of milk-leg was made. It was clearly a case of thrombophlebitis. The patient was free from sepsis at the time of the operation and the wound healed perfectly. The stitches were removed on the eighth day. The leg was wrapped in cotton, lightly bandaged, and slightly elevated. In a week the pain and swelling began to disappear, and in another week the patient was sitting up. She left the hospital six weeks after the operation, wearing

an elastic stocking. She made a good recovery, and has since been well.

CASE II.—I operated on the unmarried sister of Mrs. W. also, in my hospital, for uterine fibroids. She also had left femoral thrombophlebitis coming on at the end of the second week. Her symptoms, treatment, and results were the same as in Case I. No apparent sepsis at time of operation. Perfect healing of wound, not having even a stitch-hole abscess. Both sisters were anemic from loss of blood, previous to operation, on account of their fibroid tumors which condition may have contributed to their femoral thrombosis.

CASE III.—Also a supravaginal hysterectomy for fibroids. Operated on Miss R., in January, 1897, aged twenty-nine, also in my hospital. She had the tumor removed on account of pressure symptoms and hemorrhages. The history of this case was almost a repetition of the two above described. Her convalescence was retarded at least two weeks by this complication. She has been well ever since, and complains of no trouble whatever at the present time.

CASE IV.—Was sent to me by Dr. J. R. Bromwell. Mrs. O., aged about fifty years, mother of several grown children. Removed an eight-pound uterine fibroid by supravaginal hysterectomy, in my hospital, in February, 1900. No especial difficulty was experienced during the operation, very little blood was lost, and the patient did unusually well until the fifth day, when she began to complain of unusual pains in her legs, and oppressed breathing. She wished to change her position in bed often. During a visit from her physician on same day, upon a repetition of her request, we arranged her pillows, and lifted her into a half-sitting posture, which made her feel more comfortable. She asked for a glass of milk, and while drinking it from her own hand and talking to us pleasantly, she suddenly called out to us that she could not see, and asked the doctor

to take the half-emptied glass. We at once placed her flat in bed with her head low, thinking she was about to faint on account of the elevated position. Her mind became confused, she complained of pains in her head, difficult breathing, and choking sensations. She soon became unconscious, and her family were at once notified, and all came immediately. She did not recognize them, and died within two hours of the beginning of the attack. Nothing that we did was of the slightest benefit, and we could offer very little explanation to the shocked and sorrowing group of relatives. No postmortem was allowed. On account of the pain in her back and limbs, we arrived at the theory that a femoral thrombus was forming, and that her change from a recumbent to a half-sitting posture caused the detachment of emboli which found their way through the circulation both into the cerebral and pulmonary vessels, causing the symptoms we witnessed of cerebral and pulmonary embolism.

In pulmonary embolism alone the patient usually retains consciousness to the last.

In this case the patient was unconscious almost from the first, but as long as she was able to speak, complained of the usual symptoms of pulmonary embolism also. The progress of the patient up to the time of her seizure was as favorable as could be desired.

CASE V.—Mrs. X., wife of a farmer living in Virginia, was sent to my service in the Georgetown University Hospital on the tenth day of May, 1902, and was operated on three days later. She did well until the middle of her second week, when she developed a slight left femoral thrombophlebitis. The calf of her leg was swollen and painful, and the femoral vein could be felt under the skin about the size, length, and hardness of an ordinary lead-pencil. It was not as sensitive as the average case. Her symptoms under the usual negative treatment soon disappeared, and

she was up and walking about the ward during her fifth week without pain or inconvenience of any kind. She was preparing to leave the hospital with her husband at the end of her sixth week, restored, as she thought, to health, and very grateful and happy.

Her bag was packed, and she was sitting on the side of her bed, laughing and joking with the other patients, eating a piece of pie as her dessert, which she held in her hand like a school-girl, when she suddenly dropped the pie, clasped her hand over her left chest, gasped for breath, and, notwithstanding all that was done for her, in less than an hour she died, with all the characteristic symptoms of pulmonary embolism. No postmortem could be obtained.

CASE VI.—Was a single lady about fifty years of age. I had operated on her twice before: once for the radical cure of coccygodinia by the removal of her coccyx, and secondly for the removal of what turned out to be a non-malignant tumor in her breast.

Later on, Dr. Halsted, of Baltimore, came over and removed the other breast for what proved to be a benign growth also.

This time her troubles were caused by a bleeding fibroid, and though she was in good flesh, she was quite pale and anemic. Her hemoglobin was so low that we would have postponed her operation until it could be improved by appropriate diet and treatment while at rest in Providence Hospital, where she had a suite of apartments and two special nurses, but for the fact that she was losing much more blood every month than she could possibly make up, on account of the irritating pressure of the fibroid tumor.

On October 5, 1905, Miss E. was subjected to a supra-vaginal hysterectomy, which she bore very well. On the fifth day she began to have an evening rise of temperature and in the subsequent week a number of blood examinations demonstrated the presence of typhoid fever. There was

perfect healing of the wound, and no tenderness about the stump existed, nor were there any symptoms usual in sepsis or peritonitis following hysterectomy, and there were numerous and unmistakable positive Widal tests.

During her third week in bed she developed a left femoral thrombophlebitis, which ran its usual course, and by the time the fever had disappeared her leg gave no further trouble, except to swell when she first began to sit up and walk about the room. This was corrected by the wearing of an elastic stocking. The patient left the hospital at the end of two months, and has since been well.

If ever there was a case where one might expect a pulmonary embolism, it would seem that this was the one in which it might occur. Her past history and recent illness would all suggest its possibility, if not probability. Her enforced long rest in bed may have been a blessing in disguise.

The last two cases are rather pointed illustrations of Emmet's suggestion that it is the unexpected which often happens in pelvic surgery.

CASE VII was sent to me by Dr. H. H. Barker and operated on in May, 1905, in the George Washington University Hospital, for the removal of an intraligamentary ovarian cyst on one side, and an adherent pus-tube on the other. Both the cystic tumor and the pyosalpinx ruptured during their removal, and the pelvis was deluged with foul-smelling fluid and pus before the evacuation of these pus-sacs was completed. Drainage was opened up through the posterior cul-de-sac into the vagina, and several pitchers of hot salt solution was used in the washing-out process, which escaped through the vagina. As the oozing could not be arrested by ligatures, the pelvis was packed with several yards of sterile gauze, one end being brought out through the vagina, and the abdominal wound closed completely. The patient had been badly septic for two weeks preceding the operation, as shown by irregular chills, sweats,

daily rise of temperature and pulse in the afternoon, and confinement to bed.

The gauze was ten days in all coming away. Its gradual removal was accompanied by a horrible smelling, foul discharge, and the pelvis was irrigated with hot boracic solution for another week.

We had all the causes combined present in this case for a thrombosis of any or all kinds, and we finally got it, but not until the end of the fourth week. We had preoperative and postoperative infection, we had any amount of traumatism, and we had the pressure of the gauze packing for a week, added to that of a distended sigmoid and obstructed rectum. She left the hospital in her eighth week and gradually regained her health, and has been perfectly well for the past six months, and is now.

It would be difficult to say which of the variously stated causes produced the postoperative femoral thrombophlebitis in this case.

CASE VIII.—In October, 1904, I operated on Miss G. for the relief of a bound-down retroversion. The operation was a ventral suspension. The edges of the wound were held open by retractors, and the patient did well for ten days, when a left femoral thrombophlebitis developed. This was treated in the usual way for another week, after which the pain and swelling gradually disappeared in the left leg and appeared in the right. This kept her in bed for another week. She left the hospital wearing two elastic stockings at the end of her sixth week, and, so far as I know, has continued well ever since.

## POSTOPERATIVE EMBOLISM.

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AN embolus may be composed of air, fat, or blood coagulum, but embolism as we generally use the term refers to coagula and presupposes thrombosis. An embolus is, therefore, broadly speaking, a product of a pre-existing thrombus, and the pathology of embolism is the pathology of thrombosis. An embolus may be so small as to give no symptoms, and thus remain unrecognized, or it may be so large as to cause almost instant death.

Thrombosis (and therefore embolism) may affect either the veins or the arteries. After operations we naturally have local thrombi because of the violence done to the walls of the bloodvessels, but thrombosis may occur at a point distant from the seat of operation. It may, and often does, occur in the right side of the heart, or in the pulmonary artery, or even, though much less frequently, in the left side of the heart or in the aortic arterial system. Also, when the operation is confined entirely to the right side of the pelvis we may have thrombosis of the left femoral vein, because of blood condition of which we shall speak later.

I will ask you to keep in mind the following facts:

1. A thrombus is a stationary, localized blood coagulum within a bloodvessel.
2. Normal blood will not coagulate in normal bloodvessels.
3. To produce a thrombus there must be a change from

the normal either in the blood or the bloodvessels, or both.

4. Fibrin, which is the groundwork of a thrombus, does not exist in normal blood, but is the product of the reaction of fibrin-ferment or fibrinogen.

5. Fibrin-ferment is, in turn, the result of a combination of the normal calcium salts of the blood with the pathological element, nucleoproteid.

6. This nucleoproteid, according to the best authorities,<sup>1</sup> is produced by the degeneration of leukocytes and blood plates. Therefore, the three elements necessary to the formation of a thrombus are fibrinogen and calcium salts, which are always present in normal blood, and nucleoproteid, which is never found in normal blood.

7. There is, in normal blood, a power which enables it to neutralize or dispose of a certain amount of this nucleoproteid. It is thought that this power is derived from the endothelial cells lining the vessels. These cells are nourished by the blood circulating in the vessels and are sensitive to changes in this blood.

Those conditions of the bloodvessels predisposing or necessary to intravascular coagulation, are those which impair the integrity of these lining cells, such as

1. Traumatism (ligatures, crushing, etc.).
2. Inflammation or local septic conditions that impair the integrity of all the coats of the vessels.
3. Pressure, by which the blood flow is retarded and the nutrition of the endothelial cells is impaired.
4. Retardation of rate of flow of blood.

Haward, in his recent Hunterian lectures,<sup>2</sup> says, anything that retards the flow of blood through the heart or vessels predisposes to thrombosis or may even determine it, because the nutrition of the cells is thus impaired. In fact, he distinctly says:

<sup>1</sup> Howell's Text-book of Physiology.

<sup>2</sup> Lancet, March 10 and 17, 1906.

"In most cases diminution in the velocity of the blood flow is the proximate cause of thrombosis."

Osler, as quoted by Haward, gives the history of the formation of a thrombus as follows:

"First, the impairment of the integrity of the inner coat of the vessel from whatever cause. Then the rapid collection of blood platelets at this point, where they fuse together into a granular mass. The leukocytes quickly gather and soon fibrin filaments shoot out in all directions."

Osler saw no evidence of the disintegration of leukocytes, but most investigators<sup>1</sup> mention disintegration of leukocytes and blood plates as the source of the nucleoproteid which is necessary to the formation of the thrombus. Any excess of this nucleoproteid, over what the blood can neutralize, renders the entire body of the blood more coagulable.

If the thrombus is not infected it may become organized into a fibrous mass, or it may gradually and harmlessly be removed by disintegration. Before either of these processes is completed a portion of the coagulum may become separated and an embolus result.

Certain morbid conditions, apart from injury to the vessels, seem to be of influence in the formation of a thrombus. As I have said, Haward lays considerable stress on retardation of the flow of blood.

Sepsis may increase coagulability, presumably by causing disintegration of leukocytes, and setting free nucleoproteid, as also by introducing foreign bodies in the guise of microorganisms.

Blood saturated with carbonic acid is much more coagulable than arterial blood. Anemia and chlorosis also are generally believed to increase coagulability.

Krehl says:<sup>2</sup> "From the fact that patients with chlorosis show a tendency to the formation of venous thrombi, it has

<sup>1</sup> Howell's Physiology.

<sup>2</sup> Clinical Pathology, p. 132.

been assumed that their blood contains large amounts of fibrin-ferment, an assumption, however, which is incorrect."

Haward attempts to explain it by the statement that the increase in the number of the white corpuscles and blood platelets, together with their slow movement along the walls of the vessels "favor thrombosis." He concludes as follows:

"It would seem then that thrombosis may depend upon a variety of conditions, and is usually due to a combination of several lesions and degenerations of the vessel walls, impaired nutrition of the endothelium, retardation of the blood current, changes in the composition of the blood and in the proportions of its formed elements, the invasion of micro-organisms, any or all of these may play a part in the process, the predominant factor varying."

Haward also quotes Professor Wright and Dr. H. H. G. Knapp<sup>1</sup> as having proved not only that the blood of convalescents from typhoid fever is much more coagulable than normal, but that it contains twice as much lime salts, and implies that its increased coagulability is due to this fact.

All these conditions increase the coagulability of the blood and thus tend to the production of thrombi and resultant emboli.

Following abdominal and pelvic operations there are naturally thrombi in the vessels at the points of violence, from which emboli may be carried to the lungs.

In the femoral veins we also frequently find thrombi from which emboli may be detached. And it is by no means unknown that in the branches of the pulmonary artery thrombi form. Dr. G. Newton Pitt<sup>2</sup> found forty cases in 3218 autopsies. In fact, Playfair<sup>3</sup> attempted to establish it as a rule that seizures such as we generally attribute to

<sup>1</sup> Transactions of the Royal Medical and Chirurgical Society, vol. lxxxvi, 1903.

<sup>2</sup> Transactions Pathological Society of London, vol. xlv, p. 48.

<sup>3</sup> Ibid., vol. xviii, p. 68.

pulmonary embolism, were due to pulmonary thrombosis if they occurred before the fifteenth day after delivery. If after the nineteenth day, they were due to embolism.

Not only do we find thrombosis of the pulmonary artery, but not infrequently we have a clot forming in the heart and extending into the artery before death. And this condition is, in the great majority of cases, on the right side, obstructing the pulmonary artery. From this portions may be broken off and carried to the lungs, causing almost instant death. Or through gradually increasing obstruction of the pulmonary artery, by enlargement of the heart-clot, death occurs, but more slowly.

We may and do find a thrombus also occasionally in the left ventricle, from which emboli may be carried to any part of the arterial system. Dr. Baldy reports a case of gangrene of the arm following an abdominal operation. Dr. Richard Smith reports a case of gangrene of the leg following an operation for appendicitis. Others have reported similar cases.

Now, in the light of the above facts, let us analyze the conditions that meet us in our abdominal work.

Numerous arrays of statistics show conclusively that of all surgical operations, those connected with the pelvis show the greatest proportion of emboli following operation, and that of these, much the greater number are after-operations for fibroids.

After all operations there is, of necessity, a thrombus or thrombi, at the points of violence to the veins. If these thrombi remain local, we need not greatly fear embolism, but if, by reason of blood conditions, or an impaired state of the walls of the veins these thrombi extend till they perhaps meet a larger vein through which the blood is flowing freely, the danger of embolism is much greater. In addition to this, if we have a weak heart, there is added a possible danger of heart-clot.

Krehl<sup>1</sup> says that "marked general anemia weakens the heart, either through degeneration or malnutrition." He also says,<sup>2</sup> "If the ventricle is weakened it does not contract as completely as normal" (never emptying itself completely). Also "the result of weakening both ventricles is diminished arterial pressure, with increased venous pressure and diminution in the rate of blood flow."

Haward,<sup>3</sup> as I have shown, places marked emphasis on retardation of the blood current as a determining factor in thrombosis. But besides the weakening of the heart through general anemia and exhausting disease, we have often the added factor of the degeneration of the heart muscle which accompanies or results from uterine fibromata.

Increase of the amount of the calcium salts in the blood increases the coagulability of the blood. The relative amount of the calcium salts in the blood of patients submitting themselves for abdominal operations has never been studied, as far as I can learn, but we know the great tendency of fibroid tumors to calcareous degeneration, and it is a fair inference that in the blood of all patients suffering from uterine fibromata there is an excess of calcium salts. Moreover that this condition may readily exist in other pathological conditions may easily be inferred from the numerous instances of calcification given by Dr. Frank T. Andrews in a paper<sup>4</sup> read before the Chicago Gynecological Society in November, 1905.

We have, then, in many of the cases presenting themselves for operation, as conditions provocative of thrombosis and of pulmonary embolism:

1. Chronic exhausting diseases, with their resultant anemia and leukocytosis.

<sup>1</sup> Clinical Pathology, p. 66.

<sup>2</sup> Ibid., p. 71.

<sup>3</sup> Lancet, March 10 and 17, 1906.

<sup>4</sup> Surgery, Gynecology, and Obstetrics, January, 1906.

2. A probable frequent increase of the calcium salts in the blood.

3. The presence of nucleoproteid in the blood as a result both of the increase of leukocytes and blood plates and of traumatism.

4. Degeneration of the heart muscle as a result of general chronic anemia and of fibroid tumors, with its consequent residual blood in the ventricles and retardation of the blood current.

Therefore, it can easily be understood how a thrombus may form in the pelvic veins, the pulmonary artery, the right side of the heart, the left femoral vein even as a result of an operation on the right side of the pelvis, or in the left side of the heart or somewhere in the course of the arterial system. There is, perhaps, weakness of the heart, with consequent retardation of blood flow. The blood carries an excess of calcium salts and nucleoproteid and a very slight exciting cause may be all that is needed to precipitate a thrombus. This is supplied by a localized imperfection or fault in the endothelial lining, which may be in the heart, the arteries, the femoral vein, or elsewhere. Given this, with the specified blood conditions, and the process of thrombus-formation described by Osler will take place.

The symptoms of pulmonary embolism are generally sudden in onset. They are dyspnea, pain, cyanosis, rapid, and often irregular action of the heart. They necessarily vary according to the size of the embolus. Small ones cause sudden symptoms, more or less severe, which generally pass away with but temporary disturbance. Large ones may prove so rapidly fatal as to preclude all treatment.

Inasmuch as the pulmonary artery is not the channel of nutrition of the lungs, there are no symptoms of resulting gangrene or abscess, except in septic cases.

IS THERE ANY WAY BY WHICH WE CAN DIAGNOSE, BEFORE OPERATION, POSSIBLE THREAT OF EMBOLISM?

Mahler, in speaking of puerperal embolism, has called attention to rise in the maternal pulse as being the first sign of thrombosis.

Richter<sup>1</sup> thinks this was demonstrated beyond doubt in 63 per cent. of his cases. In 34 per cent. there was some doubt because of the presence of fever.

Krusen<sup>2</sup> has suggested an examination of the blood prior to operation, presumably with reference to excess of leukocytes and blood plates, and possibly with especial reference to an increase of calcium salts.

I would also suggest careful examination of the heart with reference to possible undue weakness. If the area of dulness is somewhat increased; if the first sound is disproportionately weak; if, after exertion, the pulse-rate is greatly increased, due allowance being made for existing anemia, and if there is a history of chronic exhausting disease, we may justly diagnose degeneration of the heart muscle, whether we detect any atheroma of the peripheral arteries or not. If in addition to this we find an excess of calcium salts, with chronic anemia, we are justified in taking all possible precautions against the occurrence of embolism.

WHAT SHALL THOSE PRECAUTIONS BE?

In all cases of chronic disease, where the indications for immediate operation are not imperative, we must give more time and attention to the preparation of our patients. We must attempt to improve the blood, increase elimination, and build up our patients in every possible way. At the

<sup>1</sup> *Archiv. f. Gynäkologie*, vol. lxxiv, No. 1.

<sup>2</sup> *American Journal of Obstetrics*, April, 1906.

same time we may attempt to decrease the coagulability of the blood. I have mentioned that in a series of experiments on convalescents from typhoid fever, Prof. Wright and Dr. H. H. Knapp found increased coagulability with twice the normal proportion of calcium salts. They state that in a series of cases, "in all of whom the blood was found to be abnormally coagulable, it was observed that the administration of citric acid (36 grains three times a day) was followed by a decalcification of the blood and a corresponding diminution in its coagulability."

Prof. Wright has also shown that the coagulability of the blood is diminished by the ingestion of alcohol and large quantities of water.

Dr. B. W. Richardson<sup>1</sup> (as quoted by Haward) shows by experiment that tobacco smoking markedly decreases the coagulability of the blood. After a long day of smoking it refused to coagulate at all, when in the same patient, blood drawn in the morning, before any smoking, would coagulate in two minutes.

Haward gives the following lists of conditions influencing the coagulability of the blood, which may be somewhat helpful.

It is increased by

Carbonic acid  
Lime salts  
Milk (because of the lime it contains)  
Magnesium carbonate  
Restriction of fluids

It is decreased by

Oxygen  
Alcohol  
Restriction of food  
Diminution of lime salts  
Large quantities of fluid  
Citric acid  
Rhubarb  
Acid fruit juices  
Acid wines  
Tobacco smoking

If before or after operation it shall seem desirable to give the patient free quantities of milk, it may be decalcified, if

<sup>1</sup> The Cause of the Coagulation of the Blood, 1858, p.101.

desired, by the addition of citrate of soda, 20 to 40 grains to the pint.

At the time of operation avoid all possible loss of blood. Be as gentle in the necessary manipulations as is consistent with thoroughness.

After the operation, keep "in touch" with the heart's action. Keep your patient quiet, avoiding sudden movements or movements that will put pressure on the pelvic veins. Keep the bowels well open with mild laxatives to avoid straining and use normal saline solution to dilute the blood and aid in eliminating calcium salts.

**HOW EARLY SHALL THE PATIENT BE ALLOWED TO GET  
OUT OF BED?**

Each case must be a rule to itself. Some surgeons think that where the musculature of the heart is in process of degeneration, heart-clot is more probable if the patient remains quietly in bed (though the danger of embolus may be lessened), because the contractions of the heart are less vigorous; the ventricles never completely emptied and the residual blood becomes very prone to coagulation. Also, that this danger is to a certain extent averted by the stronger and more complete contractions induced by the upright posture and physical exertion.

When pulmonary embolism occurs the most promising remedy is the free administration of oxygen, in the hope that the patient may thus be kept alive till the immediate shock has somewhat passed and the other branches of the pulmonary artery have adapted themselves to the changed conditions.

DISCUSSION ON THE PAPERS OF DRs. JOHNSON  
AND BOISE.

DR. CHARLES P. NOBLE.—After what has been said, it would look as though the best thing to do for our patients is to give them a drink and let them smoke before we operate on them. (Laughter.) I may say, that many of the methods suggested by Dr. Boise I have proved in practise; that is, carefully attending to these patients through the use of saline solution, stimulants, etc.; yet I have had a large percentage of phlebitis, and I am sorry to say I have had my full share of embolism. But so far as my observation is concerned, these methods, excepting giving the patients a drink and a cigar, have not influenced the frequency of embolism.

I want to call attention to one point in a paper which Dr. Baldy read before this Society last year, on fibroids, in which he states that of nineteen patients who died suddenly after operations at his hands (see *TRANSACTIONS* of last year, p. 454), thirteen were cases of fibroid tumor, whereas the number of fibroid tumor cases were only three hundred and sixty-six out of a total of thirty-four hundred and thirteen. He attributes that to some influence of fibroid tumors, on the body at large. Of 7130 women operated on in the Johns Hopkins Hospital, in forty-eight phlebitis occurred: After perineorrhaphy, four times; after hysteromyomectomy and myomectomy, nineteen times; after the removal of ovarian cystoma, nine times; after hysterectomy for carcinoma, five times; after suspension of the uterus, three times; after suspensio-uteri and perineorrhaphy, four times; after hysterectomy for pelvic inflammatory disease, once, and after miscellaneous operations, three times. Of all the hysterectomies for pelvic inflammatory disease, there was but one case. In the hysterectomies and myomectomies for fibroids (727 operations) there were nineteen cases. Presumably there were more hysterectomies for pelvic inflammatory disease than for fibroids. This is quite in accord with my own experience.

As the result of my study of the subject, I have come to the conclusion that most of our knowledge has yet to be learned. I have had phlebitis of the left crural vein twice after right nephrorrhaphy. I have had it after hysterorrhaphy. I have

had it after operations on the cervix and perineum, and the worst case I ever saw was after a hysterorrhaphy, and very few of the cases followed operation for inflammatory disease, so that it seems to me sepsis has very little to do with the question.

DR. REUBEN PETERSON.—This subject naturally interests all surgeons, and its doubtful etiology makes it doubly interesting. I think the point brought out by Dr. Johnson this morning in quoting from Dr. Kelly that we cannot promise normal convalescence in any operative case, no matter what the operation is, is well taken. My own experience and that of others support this view. Postoperative phlebitis comes on not only immediately after operation, but may appear a month or five or six weeks afterward, in cases where we least expect it.

I am particularly interested in this subject at present, because I have in the University of Michigan Hospital a patient who has an aggravated form of femoral thrombophlebitis. It appeared the third week after an operation for the removal of the appendages, while the latter were so adherent as to require removal. There was not enough sepsis connected with the case to warrant one in thinking she would have any such condition develop. But during the third week she developed thrombophlebitis of the left side, and this assumed a very severe type. The redness and swelling involved not only the femoral region, but extended also up over the buttocks.

Very soon a dark area appeared over the upper part of the left femoral and gradually a very large portion of this became necrotic. So rare in my experience was this condition that I had a picture taken so that I could present it at this meeting. You can quite readily see from the drawing that the area extends nearly across the leg. The wrinkling which you see is the outside portion of the necrotic area. The dark portion is the black slough which has not yet come away. This patient is still in the hospital; the slough has not separated, and it will be a long time before she recovers.

I have also taken the statistics of thrombophlebitis from my clinic for the last four and a half years; that is, from October, 1901, to May 15, 1906. These statistics do not include this case, because the patient has not left the hospital. They were

surprising to me, because I thought the condition was far more common in my experience than these statistics show. Perhaps this is because these complications always come unexpectedly and invariably make a deep impression upon us. I should have said the complication was three or four times as frequent as is shown by the figures.

In making up statistics one has to consider whether he shall take the entire number of operations in the female, or confine himself to the number of patients operated on. If we take the entire number of operations, we do not get the exact percentage, but taken in another way such statistics show something because we have seen that these accidents come not only from laparotomies and the more severe abdominal operations, but they follow more simple operations, like perineorrhaphies and trachelorrhaphies. I find that in three thousand operations performed in the gynecological clinic during these four and a half years there were six cases of femoral thrombosis (not counting the case I have just reported). This would give 0.2 of 1 per cent., and taking the number of patients (1050) it would be 0.6 of 1 per cent., which differs very materially from what was stated this morning by one of the essayists in quoting Hirst, who said that postoperative thrombophlebitis was as frequent as 3 per cent. Of these cases, three came from the removal of the appendages, one only from hysterectomy for fibroid, although there have been eighty or one hundred cases in which fibroids have been removed during this period. One came from simple dilatation and curettage. In one case the record was not available. The left femoral vein was affected four times, and in one case the left groin and the right leg were affected.

As regards the time of occurrence I find in one case it occurred eleven days, in two cases fourteen days, in two cases nineteen days, and in one case twenty-one days after operation. This includes those cases in which both extremities were affected. In one case the symptoms appeared in the left leg on the eleventh day after the operation, and in another case in the right leg, nineteen days after operation. Of course, one has to consider the time in the hospital and the prolongation of the convalescence, and this I have found to be thirty-seven, thirty-nine, forty fifty-two, and one hundred and one days, respectively.

DR. EDWARD REYNOLDS.—My observation has been that thrombosis occurs most frequently in women who have undergone operations for repair of retrodeviations of the uterus, in which there has been a great deal of congestion before operation. The statistics put forth by the Johns Hopkins Hospital two years ago showed that a much larger percentage of cases of thrombosis occurred following ventrosuspensions for retrodeviations of the uterus than from any other operation. I am inclined to think that these thromboses are more frequent now than they were a dozen or fifteen years ago, and that we are falling into the error of under-estimating the importance of congestion in the production of symptoms in cases in which there is an approach to a varicose condition in the broad ligaments. A dozen or fifteen years ago we were taught and believed that that was an important element in the production of symptoms in pelvic disease. At that period all of our patients were carefully prepared for operation by depletion. I am inclined to think that we are neglecting too much the treatment of congestion before operation and that we are getting too prone to operate on patients without previous preparation, and as a result we are getting thromboses. Speaking for myself, I am again becoming much more careful in regard to operating on these patients with congestion than I was at one time, paying particular attention to preliminary preparation by depletion beforehand.

DR. ANDREW F. CURRIER.—There is one point which I think was overlooked by Dr. Johnson in the paper which he read this morning in regard to the development of thrombosis, and that is the tendency which is apparent among certain surgeons at the present time to be in too great a hurry to get patients up and around after the performance of a serious operation. It seems to me that such a procedure is extremely irrational and unphysiological, for after the performance of a severe operation we have a condition of shock, a condition of depleted vitality, if I may use that expression, which can only be repaired by time. If for the sake of saving a few days, which is the argument put forth, the patient is allowed to get out of bed and walk about or to go home, we forget that we are exposing that patient to the risk of this condition which was the subject of discussion this morning.

I was impressed in this connection with the remark of Dr. Edgar this morning regarding the defective involution of the abdominal muscles immediately after labor, which is more or less analogous to the condition which follows severe pelvic operations. The same reasoning which would impel us to keep a puerperal patient in bed for a reasonable length of time ought to obtain, it seems to me, after severe operations.

Notwithstanding all the information which has been given to us in these papers this afternoon, all who have read and spoken from large experience seem to be of the opinion that we are yet in the dark as to the exact cause of embolism and thrombosis. Certainly, there are numerous causes, and I have had some cases in my own experience in which I was utterly unable to ascertain any cause. Patients have had operations which have caused no particular difficulty; their convalescence has gone on satisfactorily for a few days, yet suddenly they die, and we assume that death was due to embolus, and that if an autopsy is made we might find pulmonary or cerebral hemorrhage. In view of these facts, it is therefore perfectly clear to my mind, that after an operation a patient should be given sufficient time for convalescence and for the return of the normal blood conditions before we permit her to get up and go about.

DR. SETH C. GORDON.—Dr. Currier has stolen my thunder, but he has said what I had intended to say much better than I can. One thing that came near spoiling my coming to this meeting was a case of labor, the only case I have had the last year. It occurred in a member of one of my old families, and I could not say no. Fortunately, labor came on nine months from the day of conception, according to the testimony of the husband and wife. The woman said to me a few days before confinement: Do you adopt the new fashion of getting women up as soon as they are confined? I said, No; I have heard of that method. But, she said, that is the fashion now, and you are not in fashion unless you allow your patients to get up after confinement. I said to her: If that is the fashion, I am very glad I am old-fashioned. And that is the point I wish to make. I believe with Dr. Currier that a great many of these cases of embolism and thrombosis are due to the fact that women are allowed to get up too soon after confinement. I have never seen a sudden

death occur after labor, but I believe this too early getting up, tends to phlebitis. I have two cases of phlebitis of the femoral vein that have occurred in my own practice within the last few months. One occurred in a comparatively young woman after an operation for appendicitis. It did not come on in consequence of her sitting up, but came on two weeks afterward. The other case occurred in a gentleman, aged sixty-nine years, who was on a trip to Mexico, and who on the first day of March was taken with cerebral hemorrhage, followed by paralysis of the left side. About eight weeks after the shock or about the first of May, he was taken with a severe phlebitis of the left leg, and is just now recovering from it. This man has arteriosclerosis, and undoubtedly it is one of those cases where the fault is in the vein itself. Whether or not the condition may have been aggravated by massage that was given him, I do not know. I believe, however, that this matter of phlebitis after labor is due in a great many instances, especially in women who are advanced in life, from allowing them too much liberty. It is also a fashion with some of our young surgeons to let their patients get up and about too early after operations. Many of them would say, "I sent one patient home in nine days, and others in less time than that." That is all wrong. We should discourage that in both young and old surgeons. I believe a patient, after an operation, needs a good deal of time to get everything adjusted to the new condition of things. Therefore, I most strongly protest against the getting up of patients and allowing them to walk about early, following operations.

DR. THOMAS J. WATKINS.—There is a great deal of consolation in the possibility that these cases of thrombosis may be non-septic, but, it seems to me, the preponderance of evidence indicates that they are all due to infection. I will not discuss embolic complications, as that is another subject. As evidence of this fact: (1) Thromboses are common in cases of infectious disease irrespective of traumatism (they are common after typhoid fever); if statistics were worked up, I believe it would be shown that thrombosis is nearly as frequent after typhoid fever as it is after abdominal section. (2) Thrombosis does not occur in the non-infectious diseases.

I was interested in Dr. Clark's paper, in which he attributed

thrombosis to traumatism of the epigastric veins, but we do not get thromboses from traumatism of these vessels from abdominal contusions. Very extensive traumatism of the veins occurs in some cases of fracture and in cases of contusions, but thrombosis, as seen postoperative, does not occur in these patients. Where there is thrombosis, as found in old varicose veins, septic symptoms, as found in postpuerperal and postoperative cases of thrombosis, do not obtain. It has been said here as evidence against infection, "The non-inflammatory cases are more liable to have thrombosis than are the septic cases." It is probable that the septic cases are more or less immune and consequently not so easily infected as the "clean cases." Another statement made as evidence that these cases are not all septic is "that thrombosis occurs without suppuration or infection." I contend that it is difficult to define what an aseptic recovery is. With our present facilities for operating, probably all of our abdominal section cases have a slight amount of bacterial invasion, and we know that even if we do not admit any bacteria through the abdominal incision, still bacteria continually invade the abdominal cavity by migration through the intestinal wall. This is proved in cases of gangrene from twisted ovarian pedicle, and it is quite probable that some cases of thrombosis are not due to infections occurring through the wound, but to infection from the migration of bacteria from the intestine. In cases of old varicose veins in the legs, we frequently see thromboses, but not with the clinical picture of the postoperative variety.

DR. J. MONTGOMERY BALDY.—This is a subject that has been brought before us from time to time for many years. I read a paper on it ten years ago, and since then my ideas have swerved back and forth as to the cause or causes. As one of the first or original causes of embolism or thrombosis, we suspected sepsis; then pressure from traumatism, and pressure by retractors on the pelvic veins; yet none of the explanations seemed to be sufficiently feasible to account for a large number of cases. I investigated a series of cases recently, and in my paper read before this Society last year I reported a list of sudden deaths following operation. There were nineteen sudden deaths, as if the patients had been hit with an axe. Of this number,

thirteen occurred among the fibroid class, which were not septic cases.

The investigations made at Johns Hopkins on the same subject, revealed the presence of forty-eight cases of phlebitis. In 7130 cases there was only one that occurred in the inflammatory class. With reference to the nature of the operations performed in which thrombosis occurred, it happened "after perineorrhaphy four times; after myomectomy, nineteen times; after the removal of ovarian cystoma, nine times; after hysterectomy for carcinoma, five times; after suspension of the uterus, three times; after suspensio-uteri and perineorrhaphy, four times; after hysterectomy for pelvic inflammatory disease, once, and miscellaneous, three times." It would seem from a superficial glance at the character of the disease we are dealing with that we cannot accept the theory which Dr. Watkins has enunciated.

A fact that has appealed to me in recent years, after much thought on the subject, has been this: In an investigation I made of three thousand to four thousand surgical cases, there were nineteen deaths in a group of 366 cases of fibroid disease. This proportion of deaths draws our attention prominently to fibroid disease and an explanation is demanded. So far as I can recall, every one of these patients was a bleeder. When we take into consideration that this complication occurs in a group of fibroids (which is a bleeding disease), and think of the explanations offered by general surgeons, like Richardson, Deaver, and others, that these deaths occur prominently among bleeders, it supports the contention of Dr. Boise in regard to some blood dyscrasia.

Although I believe a certain portion of cases occur from some one of all the causes given here and elsewhere, yet I think the most potent factor lies in the direction of a blood dyscrasia, and that it is principally in this direction we must look for prevention. These cases do not occur in patients who have been up after operations, but these sudden deaths and milk-legs have occurred in patients who have never been out of bed; from the time they left the operating table they have been quietly resting in bed until attacked.

DR. LEROY BROWN.—I wish to report briefly a case of thrombosis of the subclavian artery immediately following supra-

vaginal hysterectomy. The patient was a woman, thirty-five years old. The operation was uncomplicated. There was no extra bleeding. She was put to bed in good condition. There was, however, a small mitral regurgitant murmur, but no dilatation, nor was there any hypertrophy of the heart. As soon as the patient came from under the anesthetic she complained of pain in the right arm. On examination it was found to be white; there was no pulse perceptible at the wrist, none at the elbow or in the axilla. This was three months ago. The patient made an uninterrupted recovery, so far as the operation went. There was primary healing of the wound. There was no exudate in the pelvis. Knowing that I was coming here, and having been notified that this discussion would take place, I requested some pictures to be taken, and I have here some photographs of the arm. Lack of motion is just now developing, and the fingers stand well apart with inability to bring them together. There is impaired motion in the fingers, also impaired motion in the wrist, at the elbow, and markedly impaired motion at the shoulder. There is some ischemic paralysis.

DR. JOHN G. CLARK.—In discussing the question of thrombophlebitis it would be wise to consider the general pathology and etiology rather than to narrow the subject to the point of attributing this complication to any one given cause. In certain classes of cases a given condition will undoubtedly predominate as the predisposing cause to thrombophlebitis. Thus, in a fibromyoma which has been accompanied by a rather prolonged bleeding, anemia would undoubtedly be the chief factor in the etiology of the thrombosis. In other cases, and indeed there are many, one could not attribute this condition to such a factor, for it is not present.

Dr. Johnson has referred to my series of cases and has alluded to the hypothesis which attributes the majority of cases of post-operative thrombophlebitis to traumatic pressure or injury of the epigastric vessels, which run parallel with the abdominal incision. This theory was forced upon me, for in a large series of cases which I reported a thrombus occurred more frequently in clean aseptic, simple abdominal operations, such as suspensio-uteri, than in septic cases. Likewise simple ovarian cysts were not infrequently followed by this sequel. In such cases the

thrombosis, so far as the physical appearance of the patients was concerned, could not be attributed to a dyscrasia. I refer to this point merely to emphasize what I have said in the beginning relative to the necessity for the consideration of this question from the standpoint of general causes. In simple laparotomy cases I believe that the theory which attributes this complication to the traumatism of the epigastric vessels is the one which most satisfactorily explains the accident. I do not for one moment believe that sepsis plays any part in these cases, as a rule. Upon this point, therefore, I take very strong issue with Dr. Watkins, and am glad to see that Drs. Baldy, Noble, and Johnson are likewise opposed to this view. These cases are not attended by septic symptoms and are very infrequently associated with septic infections. In only a few cases of those which I reported was there any trouble whatever with the abdominal wound, and a very difficult point, I believe, to explain, if we accept the septic theory enunciated by Dr. Watkins, is that where there is extensive suppuration of the abdominal wound this complication seldom occurs. That it is in rare cases the chief factor, however, must be admitted without question.

In the study of a large series of cases we may in one case attribute the thrombosis to anemia, in another to some one of the other general causes; but in the end I believe the conclusion will be forced upon us that the chief factor in a clean abdominal case is the traumatism to deep epigastric vessels. Since I have studied this question I have not infrequently observed deep epigastric veins as large as goose-quills running underneath the peritoneum. Traumatism incident to retraction or to the placing of sutures might readily produce sufficient injury to the wall of the vein to give rise to a local thrombosis which could readily extend into the femoral vessels, and there produce such a decided whirlpool movement, with consequent slowing of the femoral blood stream, as to bring into play all of those etiological factors described by von Recklinghausen for the formation of a thrombophlebitis.

I believe the fact that these cases do not occur for from ten to sixteen days after operation is due to the slow extension of the thrombosis along the epigastric vessels until the femoral

vessels are reached, where it produces the local symptoms. The slower the blood current the greater the danger of this complication. We may safely attribute, therefore, the greater frequency of thrombosis in the left femoral veins to the pressure of the sigmoid flexure upon the iliac vein, which naturally slows the current greater than upon the right side. In some of the infrequent cases, such as the formation of a thrombophlebitis on the left side, when a right nephrorrhaphy has been performed or after a simple incision for appendicitis, this theory will naturally not hold. These are exceptional cases, however, and in such instances we would have to fall back upon some of the general causes rather than upon the traumatic explanation.

DR. M. DUHRSSSEN.—I did not expect to be called upon to take part in this discussion. I have some difficulty in explaining my views in this very important matter. I believe that in most cases of embolus there is a blood dyscrasia, as already mentioned by some of the preceding speakers, and I believe that these cases of emboli have nothing whatever to do with sepsis. I have seen some cases of emboli follow hysterectomy for fibroids. These patients were very anemic and very weak, but they made good recoveries. They had no fever, but on the sixteenth or seventeenth day, when they were raised in bed, they had emboli. I recollect especially one case in which there was great mental excitement in an anemic woman, and when she raised up in bed on the seventeenth day after the hysterectomy she fell back dead. Therefore, when I saw Dr. Boldt operate on a very difficult case in New York, doing a hysterectomy for fibroids and pyosalpinx, and saw the same patient the next day walking around, I was astonished. I would not care to adopt that practice, for the reason that I would always fear emboli following such a course. I have not seen emboli very often, but in most cases the patients are very anemic, and in some of them there is great mental excitement. In one case I lost the patient through fear of suffering from my removing the sutures.

DR. GEORGE M. EDEBOHLS.—My own experience with thrombosis following operative work embraces ten cases observed during the past sixteen years. The first point I desire to make is this, that femoral thrombosis follows operations other than those performed upon the pelvic viscera or external

genitalia. Dr. Noble has already told you that he has had two cases following nephropexy. I have had two cases of *left* femoral thrombosis following *right* nephropexy, where the operation was completely aseptic, and the wounds healed primarily throughout. Of my ten cases, nine were on the left, and only one on the right side. Of the ten cases, not one was septic either at the time of operation or during the progress of the case subsequent to operation. There was full primary healing of the operative wounds in every case. These facts are not readily reconcilable with either of two theories, that of interference with the epigastric vein, and that of sepsis, advanced to explain the causation of femoral thrombosis after operation. In all of my cases the thrombosis occurred between the eleventh and nineteenth days after operation, while the patients were still in bed.

DR. RICHARD R. SMITH.—I wish to report a case of thrombosis of the left leg following an operation for appendicitis. The healing of the wound was perfect. There was no pus at the time of operation. The patient, however, had a stormy convalescence and became very weak; the pulse became rapid as well as weak. He went along for two weeks, then suddenly developed a thrombosis of the left femoral artery. The man recovered with the loss of his leg, however, above the knee. Examination of the heart was made daily before the occurrence of the accident, as well as afterward, without finding anything that would give us a clue as to the cause of the same.

DR. RICHARD C. NORRIS.—From our experience I think we must conclude that there are many factors in the production of thrombosis, and that each individual's experience being necessarily rather limited, we will find that phlebitis is due to various causes.

I wish to call attention to a case of thrombosis in the left leg following an Alexander operation, in all probability due to the traumatism of a retractor. So far as I know, no one has discussed the cause of thrombosis following Alexander's operation. In this case, on the left side there was some difficulty in finding the round ligament, consequently the retractor was used more freely and frequently than is customary.

As bearing upon traumatism as an etiological factor, I would call attention to several cases of mild phlebitis I have observed

in the abdominal wall which, I believe, followed the Credé method of placental expression, and I believe if obstetricians were to observe the abdominal walls of their patients, they would not infrequently find a small vein thrombosed; being covered by the binder and pad it is overlooked.

There are undoubtedly cases of embolism produced independently of traumatism. I have the records of two severe cases of thrombosis of the left femoral vein occurring during pregnancy, and scarcely a year goes by at the Preston Retreat that I do not have a case of inflamed varicose veins of the leg. We must conclude that there are many factors which bring about this condition, as emphasized by Dr. Boise, and that the etiology of its occurrence after operations for fibroid tumors cannot apply to other cases.

As to the relation of this condition to the early getting up of patients, I would like to mention the records of the Preston Retreat again. During the service of Dr. Goodell, which covered a period of seventeen years, it was his custom, as the older members of the Society will recall, to get women up early after confinement, in order that better drainage of the lochial discharge might be afforded. When I took charge of the Preston Retreat—and the practice of Goodell was followed by Price—adjacent to each bed was a commode. It was then the custom to have women get out of bed on the fifth or sixth day after confinement to use the commode. A careful search of the records, which comprise approximately eight thousand deliveries, could find no sudden death following this custom, and the records of my own institution are against the early getting up as being an important etiological factor in puerperal cases. The more we study this affection, the more mysterious it is. The progress of some cases after the occurrence of thrombosis is also mysterious. In the older books the records of suppurations of the thigh, followed by recovery, were not uncommon, and the method proposed of injecting turpentine in order to favor localization of the infection may have some value.

I believe that local suppuration or a general infection will be determined by the blood condition of the patient, and the character of the infecting organism. I am sorry to record that before leaving home the first death occurring in my private obstetric

practice in fifteen years from any cause was due to phlebitis. The patient died two months after her delivery. After her apparent recovery from phlebitis of the left leg, there appeared over the right hip-joint an erysipelatous area, which was followed by skin eruptions, profound sepsis, and death. Streptococci were found in the blood.

In conversation with a professional friend, who has been interested in blood examinations of cases thought to be rheumatism, he told me that in recent years he has found that very many so-called cases of acute inflammatory rheumatism are in reality streptococcal infections with joint manifestations. He has abandoned the use of the salicylates and the uric acid theory in a certain percentage of such cases, and has been treating them with serum. My patient's history was that, when she was two months pregnant, she was treated in Paris for inflammatory rheumatism with high fever and marked joint symptoms. She returned to this country, and was treated for a similar condition at Atlantic City, and while under my care two months prior to her delivery I gave her aspirin and antirheumatic remedies for joint symptoms, with apparent benefit. Associated with her phlebitis, she had pain and swelling of the wrists, and redness and swelling of the ankle-joints. I mention this case because it may, possibly, throw some light on the clinical history of some fatal cases. A quiescent blood infection antedating delivery will find the thrombus of phlebitis a ready means of intensifying itself so rapidly that the patient cannot survive.

DR. HENRY P. NEWMAN.—In discussing this subject I think we should bear in mind that infection is only a relative term, its interpretation depending in a great degree upon such considerations as the susceptibility of the patient to trauma and the condition of his blood and tissues. As Dr. Watkins has intimated, we cannot say with certainty in any case that there is absolutely no bacterial invasion even if there are apparent no direct manifestations of infection. You will pardon me if I illustrate with a chapter from experience. As some of you will remember I was present at the Atlantic City meeting of the American Medical Association two weeks after undergoing appendectomy at the hands of one of the most experienced and painstaking surgeons in the West. It was a simple catarrhal

appendix with slight adhesions and a sharp kink which had caused attacks of colic. There was no difficulty whatever attending the operation, and ordinarily recovery would have been prompt and complete, and I looked for nothing but benefit from my trip to Atlantic City. The abdominal wound had healed perfectly and without incident, but my general condition was somewhat below par and the tissues consequently susceptible. I was hardly aboard the train before temperature, pain, and swelling announced the development of a phlebitis of the right limb, severe enough to trouble me for a year and a half. This seems to me to instance very clearly the contention that, while trauma is undoubtedly a factor in these, the susceptibility of weakened tissue, a condition of lowered vitality lessening resistance, renders many liable to a degree of invasion that most constitutions are proof against. There can be no such thing as sterile surgery, and notwithstanding the practical immunity from infection by modern aseptic methods we have still and we may continue to count upon the menace of the occasional germ.

DR. JOHNSON.—So many of the Fellows have spoken on this subject, that it will be impossible for me to take up the points made by each speaker, and as no one has taken any exception to what I have said, there is very little left for me to say. The point in regard to too early getting up made by Dr. Currier was a good one. About a month ago, while in New York City, I was asked by Dr. Boldt to see him operate for the removal of a fibroid tumor. He told me that he expected to have the patient walking about in the afternoon; if not, the next day. That statement nearly took my breath away. He said that was his custom. I told him that I was writing a paper on this subject and was looking up the causes for the occurrence of thrombosis and embolism following gynecological operations; that I had an idea that many cases were caused by the too early getting up of patients, by too much moving around in bed, or by too much manipulation on the part of the surgeon. He said that he had been getting nearly all his patients up within a week after operations, and many of them within three or four days, some of them within two days, and yet he had never attributed thrombosis to this cause. That adds another mystery to the subject.

DR. BOISE.—I have very little to add. We are all pretty well convinced at present that we do not know what the cause of thrombosis is, but I think we can say as regards the cases that have been reported that it is not always due to sepsis. Sepsis may be an important causal factor in certain cases, but it does not enter into every case. Nor can we say that it is due to an extension from the epigastric vein, because the condition occurs many times in cases where these veins have not been disturbed. We see operations done on the right side of the pelvis where the left side is not disturbed, yet thrombosis of the left femoral vein will occur. We are obliged to admit or to come to the conclusion that there are several factors entering into the different cases of thrombosis, and that we cannot attribute all cases to any one factor or series of factors. I believe that blood conditions or dyscrasiæ are the most constant factors of all.

Speaking about thrombosis following typhoid fever, it has been shown by experiments that in the early stages of typhoid fever the blood is less coagulable than normal. In the convalescent stage it is twice as coagulable as normal, and there is twice the normal amount of calcium salts in the blood.