

REPORT
of
COMMITTEE ON THESIS

The undersigned, acting as a Committee of the Graduate School, have read the accompanying thesis submitted by Henning Fritzhof Blomberg Wiese, for the degree of Master of Science in Surgery. They approve it as a thesis meeting the requirements of the Graduate School of the University of Minnesota, and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science in Surgery.

W. E. Lister ----- W. E. L.

†
Louis B. Wilton -----

E. S. Judd ----- E. S. Judd

February 1, 1921.

THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

Report
of
Committee on Thesis

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Chairman

S. F. Richards

Date _____

THE UNIVERSITY OF MINNESOTA

GRADUATE SCHOOL

REPORT

OF

Committee on Examination

This is to certify that we the undersigned, as a committee of the Graduate School, have given Hemming F. Blomberg Wiese final oral examination for the degree of Master of Science in Surgery. We recommend that the degree of Master of Science in Surgery be conferred upon the candidate.

Louis B. Wilson
Chairman

W. E. Sistrunk

E. J. Judd

J. J. Pemberton

February 3, 1921.

THESIS

POST-OPERATIVE THROMBO-PHLEBITIS

Henning Fritzhof Blomberg Wiese, M. D.

Submitted to the faculty of the Graduate School of the
University of Minnesota in partial fulfillment of the re-
quirements for the degree of Master of Science in Surgery.

May, 1922.

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Next to wound-infection and inflammatory pulmonary conditions thrombo-phlebitis is one of the most common post-operative complications, and a much dreaded one on account of its relation to the lurid menace of the grave condition, - pulmonary embolism. The importance and frequent occurrence of the latter as well as the causes of the same and means of preventing it, were first pointed out by American surgeons, while the pathological understanding and foundation mainly were laid down by the Germans.

Thrombosis might be said to be the coagulation of the blood in the vessels during life. The complicated chemical processes of the clotting of the blood consist mainly of the transformation of the fibrinogen of the blood into the elastic, stringy fibrin (and fibrinoglobulin) under the influence of thrombin, that is, the blood's thrombogen (prothrombin), activated by thrombo-kinase in the presence of lime salts. The thrombo-kinase is supposed to be derived from the leukocytes and especially from the platelets; anything that increases the number of platelets in the blood will thus also increase the coagulability of same (Morawitz).

Another theory for coagulation is Howell's, based upon the disturbance of balance between prothrombin and "antithrombin". This disturbance is brought about by a substance, "thromboplastin", given off by injured tissues or cells. The thromboplastin neutralizes the antithrombin, making the prothrombin free, so that the latter can form thrombin, with the aid of calcium.

In the coagulation of the blood in the vessels intra vitan (thrombosis) the formation of fibrin is always preceded by an agglutination of cells (platelets), after their having suffered some kind of injury. (McCallum.)

Frequency of Occurrence.

The statistics giving the frequency with which these complications - thrombosis and embolism - occur differ considerably. But they all agree in one

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thing, - that they are far more frequently seen after laparatomies than after other operations. Professor Dr. Fehling has in a recent work put together the reports from many different authors and finds:

In cases of laparatomies: 2.3 per cent thrombosis. 0.86 per cent pulmonary embolism. In cases of non-laparatomies: 0.9 per cent thrombosis.

In trying to go over the material, regarding this matter, at the Mayo Clinic for two previous years (1919 and 1920) we have met with several obvious difficulties, making it almost impossible to give dependable figures as to percentages of occurrence of thrombosis in different respects. Thus, to be reliable a clinical study would for instance require a very complete history-taking (previous diseases, child births, both with eventual complications, etc.), just as thorough a general examination (varices etc.), intelligent postoperative observations and notes, correct diagnoses, the possibility of this complication kept in mind all the time. Even if not all of our cases have been worked up equally well in these different respects, it might be of some interest to go through the great material in this clinic also with regard to the question of post-operative thrombosis or thrombophlebitis.

In the records of the cases operated on at the Mayo Clinic (St. Mary's and Colonial Hospitals) during the two years 1919 and 1920, we have found ninety six cases in each of which there was made a diagnosis of thrombosis or thrombo-phlebitis of the lower extremities after the operation.

During the same space of time there were forty-eight cases that intravital or post-mortem were diagnosed pulmonary embolism. Seven of these got well; of the forty-one who died, there were ten cases in which the post-mortem examination showed marked previously undiagnosed thrombosis of the iliac, femoral or pelvic veins. These ten cases will therefore be considered together with our ninety-six cases of diagnosed thrombo-phlebitis,- thus making 106 cases in all. (Besides there was record of one patient who had chronic phlebitis before

the operation (cholecystostomy) for acute suppurative cholecystitis, and died eight hours after the operation from pulmonary embolism.)

It is hardly necessary to mention the difficulties in making a correct diagnosis of post-operative thrombophlebitis of the lower extremities in many cases. How much attention do we, for instance, have to pay to the well-known "soreness" and tenderness of the calf of the leg after operations especially making their appearance on the first day the patient is up and out of bed? Also, in several of our cases the diagnosis seems questionable mainly perhaps on account of the mild degree of the symptoms in these cases.

The same doubt as to a correct diagnosis also applies to cases of pulmonary embolism, patients with broncho-pneumonia, lobar pneumonia, fat-embolism or heart-insufficiency sometimes being held for straight pulmonary embolism cases, while we on the other side feel that many cases of real pulmonary embolism are overlooked.

Sex.

Of our 106 cases of thrombophlebitis, seventy-eight were female and twenty-eight were male.

This relation mainly depended upon the larger number of laparotomies in women (pelvic operations, gall-bladder operations).

Of the women seven were unmarried, seventy-one were married, eighteen of whom had had no children, two only miscarriages, and fifty-one had had from one to eleven children. Twenty-five women were past menopause from one to twenty-four years.

<u>Age.</u>	<u>Female</u>	<u>Male</u>	<u>Total</u>
18 years old	1		1
20-29 years old	4	1	5
30-39 " "	14	6	20
40-49 " "	26	8	34
50-59 " "	27	7	34
60-69 " "	6	6	12
	<u>78</u>	<u>28</u>	<u>106</u>

We thus find most of our cases between the ages of thirty and sixty years, and in percentage of the number of cases operated upon more often the older the patients are.

This more frequent occurrence in the older age brings us near the question of etiology.

Etiology of post-operative thrombo-phlebitis.

This question has been answered differently, and the authors do not yet agree. Besides von Recklinghausen's idea of an "individual disposition" of the venous system for thrombus-formation there are two opinions as to the main factor in the etiology, namely:

the mechanic principle and that of an infection.

Most of the authors apparently seen at the present time to be adherents to the infectious theory, although on the other hand several recent writers have weighty reasons for giving the mechanical viewpoint priority. In their opinion some straight mechanical obstruction and slowing down of the blood-stream are the main causes of this complication. The formation of "eddies" at the valves of the veins, for instance, is supposed to be especially important.

That a direct infection of the wall of the veins from the outside might take place during an operation or as a result of same, followed by thrombo-phlebitis, is very likely, and of course especially so in septic cases. But, on the whole, this complication seems to be almost as common after so-called "clean" operations as in cases where one would imagine the danger much greater on account of infected fields during the operation. Statistics from the great war for instance seem to show that there were very few cases of thrombo-phlebitis in spite of all the kinds of severe injuries and septic wound conditions of the lower extremities. Also, the rarity of diagnosed septic embolic processes in the lungs might be seen in the same light, although it seems that such processes really may take place, are diagnosed as pneumonia, and that the lungs take

care of them like pneumonia without any further trouble (Capelle).

In the Mayo Clinic Dr. W. E. Sistrunk about three years ago started a system of "grouping" the operated cases on the wound's chance of becoming infected from more or less soiling during the operation - in other words, on the "cleanness" of the operation.

Groups 1 and 2 consist of clean cases (without and with drainage), the wounds having no chance of becoming infected from the nature of the operation. (For instance Group 1, hernia operation without drainage; Group 2, thyroidectomy with drainage.)

Groups 3 and 4 contain the cases where there is a possibility of infection during the operation from opening of the bile ducts, stomach, intestines etc. (For instance Group 3, gastro-enterostomy without drainage; Group 4, cholecystectomy with drainage.)

Group 5, all other cases, "unclean" cases. (For instance vaginal and rectal operations; all pus cases.)

Our cases of thrombo-phlebitis fall in all "groups", but of course especially in Group 3 (laparatomies without drainage).

Groups 1 and 2	11 cases
Group 3	47 "
Group 4	16 "
Group 5	24 "
Groups 1 & 5	4 "
Groups 3 & 5	2 "

Wound infection after the operation was unusually frequent in our cases of thrombophlebitis.

Purulent drainage: twenty-three cases,
 (17 in Group 3 or 4
 5 in Group 5
 1 in Group 1 & 5)

Sero-purulent drainage: five cases,
 (1 in Group 1
 4 in Group 3 or 4)

Infected skin-sutures: six cases,
 (1 in Group 2
 5 in Group 3 or 4)

Also, infection of the endothelium of the vessels from the blood seems probable in many cases, thus causing the "primary injury" to the wall, that allows the production of the thrombo-kinase or thrombo-plastin (McCallum).

The fever, usually going with the post-operative thrombo-phlebitis, the local tenderness and the increased number of cases during epidemics of infectious diseases, seem all to favor the infectious theory as to the etiology.

The more frequent occurrence of post-operative thrombo-phlebitis in the age over forty, on the other hand, supports the opinion that this complication depends upon mechanical factors, mainly consisting in circulatory disturbances from a weakened heart. Fehling mentions from his own experience during the last war the greater frequency of post-operative thrombo-phlebitis among the older soldiers than among the younger ones, under the same conditions otherwise (same operations, heavy loss of blood, etc.).

Partly in the same light does he also see the fact that post-operative thrombo-phlebitis is more common than puerperal thrombo-phlebitis (after laparatomies, 2.3 per cent thrombosis and 0.86 per cent pulmonary embolism; in puerperium, 0.48 per cent thrombosis and 0.06 per cent embolism), the majority of operated patients being over thirty years of age, of the confinement cases under this age.

The comparatively frequent occurrence of thrombo-phlebitis after operations below the diaphragm (and especially laparatomies) has been pointed out by many authors.

The reason for this fact has been seen (de la Camp, Hasse, Capelle) in the influence of the diaphragm's normal movements upon the circulation in the sub-phrenic vein-trunks, and in the changed modus of respiration after a laparotomy. To immobilize the wound as much as possible the patient naturally

avoids the use of the diaphragm and the abdominal wall, showing the typical high costal breathing. The falling away of the influence of the diaphragm upon the return of the venous blood through the vena cava inferior normally having its optimum during expiration means a slowing down of the blood stream with increased danger of thrombus formation.

Capelle also draws attention to the fact that most of the cases of embolism occur between the tenth and the twentieth day after the operation, simultaneously with the resumption of the normal, more abdominal respiration. Of our 106 cases of post-operative thrombo-phlebitis, eighty-one had had laparatomies done (counting umbilical and ventral hernias, and operations on kidney, ureter and bladder).

Thirty one of our forty-eight cases of pulmonary embolism were laparotomy cases, the embolism setting in on the fourteenth to fifteenth day after the operation, as an average.

That the thrombosis has its places of predilection in the veins of the lower extremities and the pelvis seems to favor the mechanical idea as to the etiology. If infection were the main cause one would expect to find this complication in any other operated region of the body as well (Fehling).

Of other etiological factors can be mentioned changes in the walls of the vessels aside from infection, for instance, as a result of old age, (although such changes usually concern the arteries), or from chemical influences. Also changes in the blood, its coagulability and viscosity under certain conditions and circumstances, for instance, during pregnancy or after influence of certain poisons (abrin, ricin) or toxins (in combustions or eclampsia) without changes in the walls of the vessels, have been much discussed as probable causes for this post-operative complication.

Many of these features seem to play a predisposing part to a certain degree. Among these has also often been counted general inhalation

anesthesia. Most of our 106 cases have had ether narcosis, like the greater number of all operated cases during these two years, with an average use of 5.1 oz. of ether (open mask). Only four of this series were operated in novocain local anesthesia.

Comparing the frequency of thrombosis after general inhalation narcosis and after spinal anesthesia, Friedmann finds practically no difference, 2.06 per cent after general anesthesia, 2.22 per cent spinal anesthesia. Of other predisposing factors must above all be mentioned varicose veins of the lower extremities. This condition is so common that it is difficult to make out how much importance has to be put into it in the different cases; a careful-pre-operative routine examination with special regard to this condition would be required to find this out.

The varicosities of the lower extremities will often be a sign of the lowered power of the heart, but far from always. The bearing on the embolism question has been pointed out by Capelle; thus in the cases of post-operative "embolic pleuro-pneumonia" (the result of small emboli) 25 per cent of the patients previously had varicose veins but no peripheral thrombosis could be found. In the cases of larger and fatal emboli considerably more than 50 per cent had suffered from varicose veins, and many of them showed clinically thrombosis of *venae femoralis* or *saphena*. Of our 106 cases of thrombo-phlebitis varicose veins were mentioned in the histories of fifteen cases, ten female and five male patients, Six times they were bilateral, twice on the right side, twice on the left side, five times mentioned only as present. Among our forty-eight cases of pulmonary embolism we have on record only six patients having had varicose veins before the operation.

The frequency with which post-operative thrombo-phlebitis involves the left leg has often been referred to in the literature on the question of the etiology of this complication and has been taken in aid of the mechanical

theory, usually supposed to be due to the less favorable circulatory conditions on the left side than on the right. These are pressure on the vena iliaca commun sinistra from the crossing of three arteries, the artery iliaca commun dextra, the artery sacralis media and the artery hypogastrica sinistra; this same vein's more angled outlet into the vena cava inferior; and the left spermatic vein's running into the left renal vein, not directly into the vena cava inferior as it does on the right side.

In our series thrombosis on both sides occurred in 25 cases		
	left side	44 "
	right side	28 "
	side not mentioned	9 "
		<u>106</u>

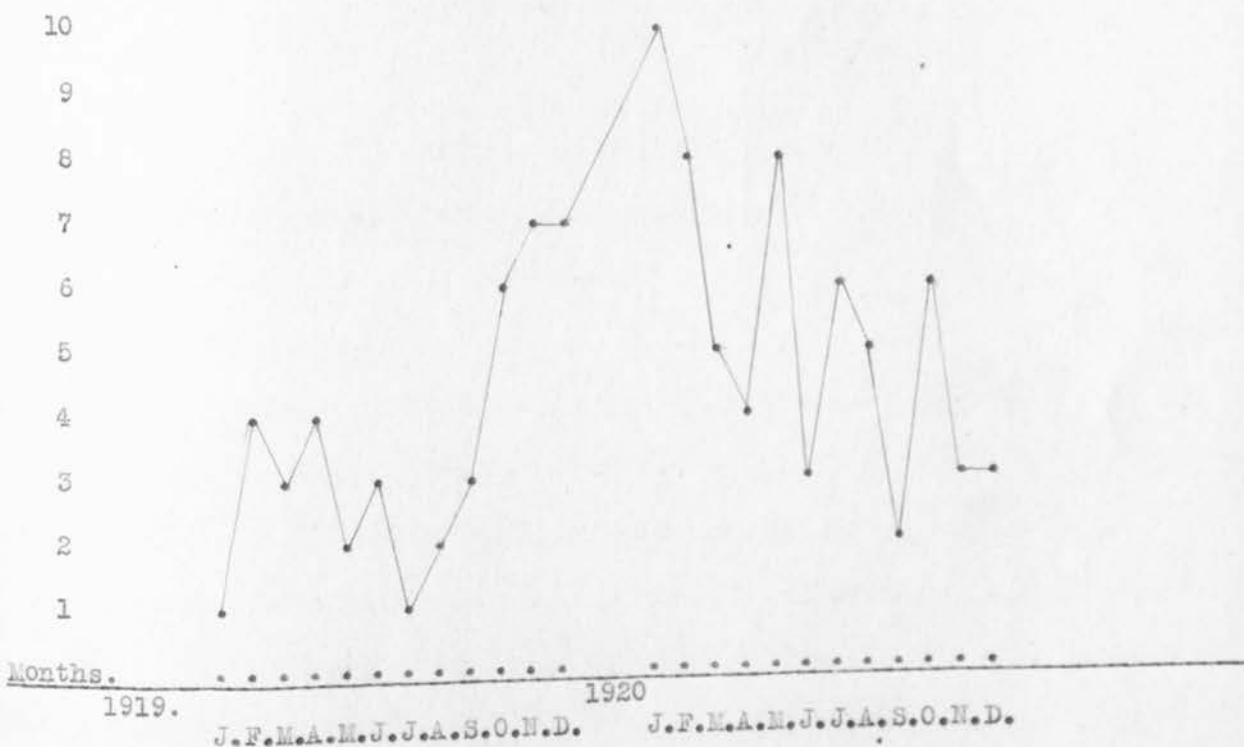
Some other mechanical factors might in certain cases be of etiological importance, for instance, pressure from a dilated ureter or from a pelvic hematoma after a hysterectomy.

Somewhat interesting in the light of the etiology seems the distribution of our cases over the different months of the year. Forty-three of them occurred in 1919, sixty-three in 1920.

We found this complication in every month of the year, but decidedly more frequently in the winter months of 1919-1920, simultaneously with the second epidemic of influenza in this part of the country, particularly severe in January and February 1920. During these months there was also a marked increase in the number of all other post-operative complications (pulmonary diseases, peritonitis, etc.), in spite of the very greatly reduced number of patients operated on during that period.

	<u>1919</u>	<u>1920</u>
January	1 case	10 cases
February	4 cases	8 "
March	3 "	5 "
April	4 "	4 "
May	2 "	8 "
June	3 "	3 "
July	1 case	6 "
August	2 cases	5 "
September	3 "	2 "
October	6 "	6 "
November	7 "	3 "
December	7 "	3 "

No. of cases:

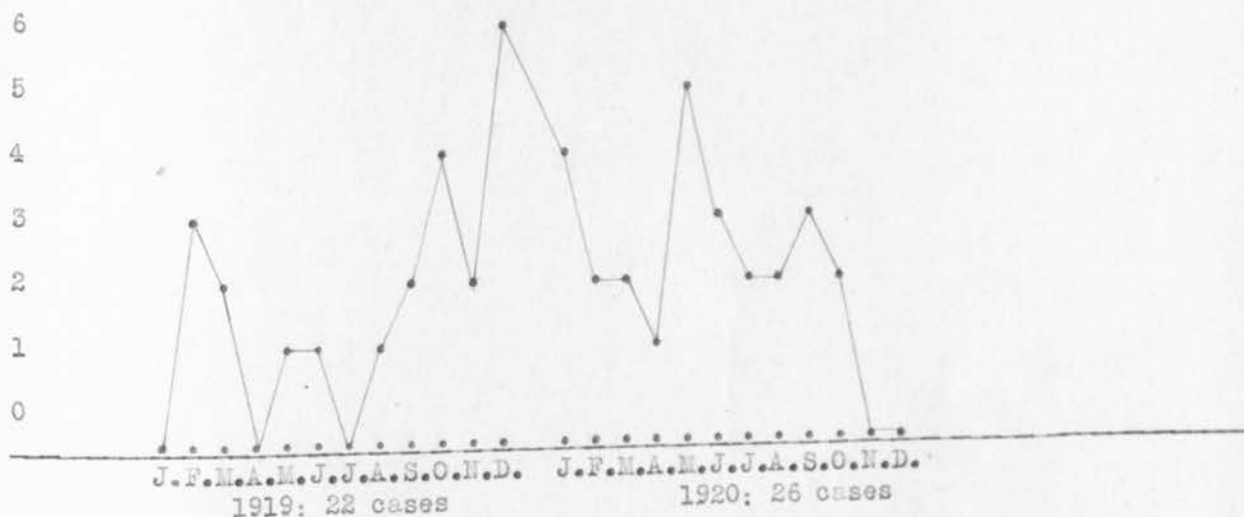


Of course, the figures are small and scarcely permit any conclusions; besides there is the possibility that a mistaken diagnosis arises especially during the winter months (rheumatism, etc.) although the difference between the years 1919 and 1920 is evident.

Thus, there seems to be a certain relationship of the complication thrombo-phlebitis to the epidemic that began around New Years, 1920 and lasted for several months, causing so much trouble and so many difficulties in surgical

hospitals that practically all major operating was suspended.

In comparison we find the same tendency among forty-eight cases of pulmonary embolism during the same two years with regard to the occurrence in the different months, although less conspicuously.



The more frequent occurrence of these complications simultaneously with epidemics of infectious diseases would seem to support the theory of infection as the real cause. But, as mentioned, many other factors favor the mechanical theory and the question seems far from being decided.

In looking over our case records from a clinical viewpoint we find in the family histories not much of special interest. Besides a number of deaths from carcinoma, tuberculosis, apoplexia, pneumonia, cardiac and renal disorders as expected, we find in three cases the mother and in two cases a sister of our patients died after child-birth. One patient's mother died from blood poisoning after miscarriage. Death from typhoid-fever had occurred in two patients' families (one father, one sister) from diabetes in three patients' families (two fathers and one mother).

An analysis of the occupations of the patients and their husbands does not give us any information as to the classes of the population particularly

disposed to this complication. They are hard-working laborers (manual laborers, farmers, mechanics, carpenters, etc.) as well as people with more quiet occupations (office workers, business men).

Previous diseases of our patients.

In the case records we find that our patients were supposed to have had previous diseases as listed below:

14	typhoid-fever
7	malaria
3	phlebitis during pregnancies
3	other phlebitis (one ulcer of the leg)
2	child birth fever
2	previous post-operative phlebitis
1	puerperal toxemia (eclampsia? uremia?)
9	jaundice (including jaundice in connection with gall bladder attacks.
18	rheumatism, seven of whom had rheumatic fever.
19	pleurisy
30	tonsillitis
12	pneumonia
12	diphtheria
14	scarlatina
9	measles
2	small-pox
3	blood-poisoning (from finger; two--syphilis)
1	erysipelas
3	parotitis
3	tuberculosis
6	gonorrhoea
10	menorrhagia
6	goiter.
44	influenza (grippe)

Previous operations were noted as follows:

7	laparatomies for pelvic disease (hysterectomy or salpingectomy, two had also appendectomy; one had also repair of cervix).
4	gall-bladder operations (two had also appendectomy, one followed by post-operative thrombo-phlebitis).
3	appendectomies (one of them followed by post-operative thrombo-phlebitis.
1	paracentesis abdominis.
6	perineum and cervix operations.
5	kidney, ureter or bladder operations
6	curettement of uterus
1	operation for vesico-vaginal fistula.
1	tube resection for carcinoma of recto-sigmoid
6	rectum operations (hemorrhoids, fistula ani, ulcer)
1	induced abortion (6 months) for toxemia (followed by thrombo-phlebitis).

- 3 tonsillectomies
- 1 thyroidectomy
- 4 preoperative blood transfusions, three of them 1 day before operation; one 4 and 10 days before.
- 1 herniotomy
- 1 incision and drainage of leg, the same leg that later showed the postoperative thrombosis.

The general condition of patients before the operation was noted as follows:

Weight loss: Thirty-three of our cases had lost from 6 to 50 lbs., 18 lbs. on an average, during a period varying from a couple of months to two years previous to the operation. This may be seen as a consequence of the great number of operations for malignant diseases.

Loss of strength: Thirty-five cases, most of them to a slight degree; more marked in three or four patients. Only four patients had to stay in bed for any length of time before the operation.

Physical examination: The general examination of the patients did not give any data to mark them out in particular.

Blood pressure: As one would expect from the age of most of our patients a moderate hypertension was not uncommonly found. A systolic blood-pressure of 140 and higher (up to 226) was found in forty-three patients; 145 and more in twenty-seven patients, and above 155 in fifteen cases. A low systolic blood pressure was not frequently met with. Systolic blood pressure between 110 and 119 was noted in fifteen cases; two patients had systolic blood pressure of 100 and diastolic blood pressure of 70.

Blood-picture: Thirteen patients had hemoglobin of 30 to 60. Fourteen patients had less than 4 million red cells (no case lower than 3 million), all anemias being of the secondary type. Seventeen of our patients had a leukocyte count of more than 10,000, the highest count being 20,200.

Elevation of temperature: Elevation of temperature before the operation from various reasons (present infection of a different kind) was seen

in twelve cases. Eleven had temperature between 99 and 100, and one had a temperature of 101 (reaction after blood-transfusion). Infections present at the time of operation, not counting cases of chronic pelvic infection or cholecystitis, were noted as follows:-

Acute gangrenous appendicitis, peritonitis	1 case
Acute cholecystitis	1 "
Infected hydronephrosis	1 "
Pyonephrosis with perirenal infection	1 "
Recent epididymitis	1 "
Pyometra	1 "
Gangrene of foot	1 "
Varicose ulcer of leg	1 "
Ulcerating carcinoma of breast	1 "
Bedsore	1 "
Chronic osteomyelitis	1 "
Purulent sinusitis	1 "

Heart: Fourteen patients had systolic murmur at apex, pulmonary or aortic areas. Three patients had "hypertrophy". Three had hypertrophy and systolic murmur; two had accentuation of "a²"; three had extrasystoles and one had in addition systolic murmur at apex.

Edema: Edema was noted in fifteen cases, more marked in four; the others were light cases.

Tortuous arteries: In the records of five of our cases tortuous arteries had been mentioned. Slight jaundice was present in one case, questionable in another one.

Constipation: Forty-six patients mentioned constipation but mostly in mild degree and very likely without much significance.

Tonsils: A routine examination of the tonsils showed chronic tonsillitis (septic or fibrous tonsils,; tonsils with fluid pus, with plugs, etc.), in forty-eight cases, Grade 1 (mildest) in sixteen, Grade 2 in twenty-five, and Grade 3 in seven cases.

Teeth: (sepsis 1, 2, 3 and 4)

Sepsis 1, 27 cases

" 2, 16 cases

Sepsis 3, 16 cases

" 4, 3 "

62 cases.

It is of course difficult to know what importance can be attached to these different factors especially since we are unable to draw a comparison to all other cases, i.e. those that did not suffer from this complication.

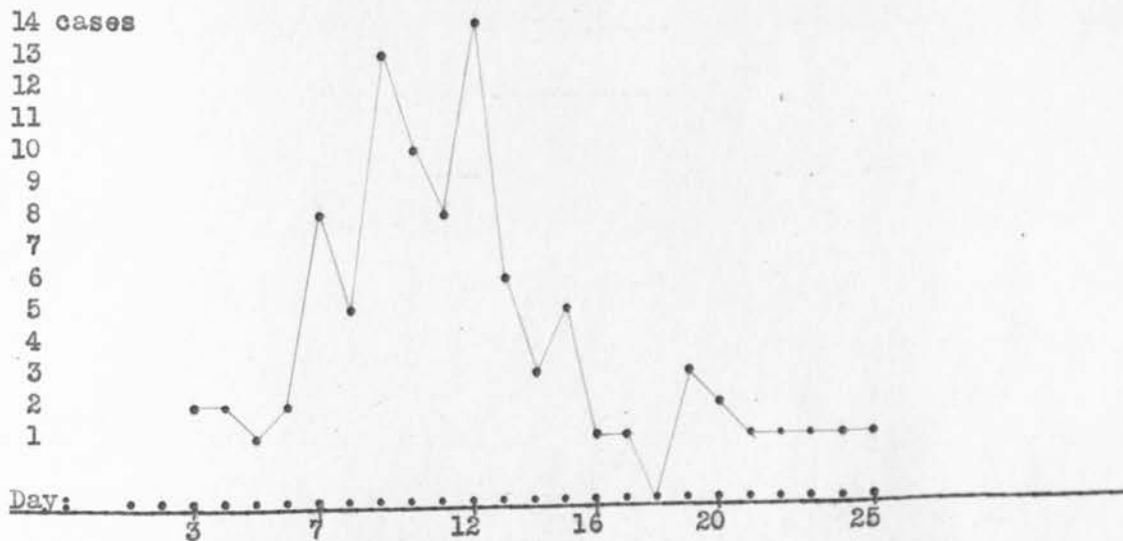
The following grouping of our patients from their general type may be of certain interest: "Fleshy", forty-four patients; "medium", thirty-nine patients; and "thin", eleven patients. This, we feel, is a considerably higher percentage of cases belonging to the first group than will be found among patients generally coming for operation, and might have some bearing upon a predisposition of the corpulent patients for postoperative thrombo-phlebitis.

Symptoms

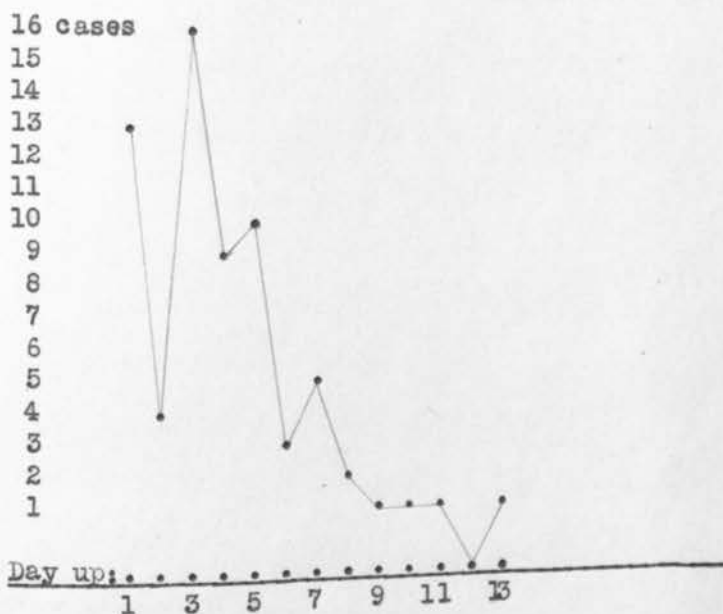
The onset of the symptoms of thrombo-phlebitis, (that is, the period after the operation on which the diagnosis was made) was in this series:

3rd day	2 cases
4th "	2
5th "	1
6th "	2
7th "	8
8th "	5
9th "	13
10th "	10
11th "	8
12th "	14
13th "	6
14th "	3
15th "	5
16th "	1
17th "	1
19th "	3
20th "	2
21st "	1
22nd "	1
23rd "	1
24th "	1
25th "	1

Thus the condition is seen to develop in the majority of the cases from seven to twelve days after the operation.



Twenty-four of these patients had not been out of bed when they began to show symptoms. Of the others thirteen showed the first sign of thrombosis on the day they got up and out of bed; four on the second day; sixteen on the third day; nine on the fourth day; ten on the fifth day; three on the sixth day; five on the seventh day; two on the eighth day; one on the ninth day; one on the tenth day; one on the eleventh day, and one on the thirteenth day.



The first symptom of postoperative thrombo-phlebitis of the lower extremities is usually pain in the leg, more often in the calf of the leg; then follows edema around the ankles and later swelling ascends sometimes to the thigh, fever and faster pulse.

Vein femoralis is often palpable as a cord, tender to pressure. While the thrombosis during pregnancy most often is situated in the superficial veins (vena saphena major and minor in 65.5 per cent - Junge) we usually find the postoperative complication as a deep-seated affection in vein femoralis or iliaca.

The symptoms in our cases were:

Pain in the ankle, calf, popliteal space, thigh, along the saphenous vein and along the femoral vein, groin and hip was mentioned in the postoperative notes in sixty-five cases (sixty-one times as the first sign of this complication).

Edema of ankle, foot or shin, swelling of calf, thigh or groin, twenty-nine cases (thirteen times as the first symptom).

Tenderness on pressure in calf, along saphenous or femoral vein or in groin in fifty-one cases (twenty-two times mentioned as first symptom).

Tender lump in groin or calf of the leg, induration below groin or along saphenous vein, eight cases.

Palpable, thickened vessels (vena saphena or femoralis) eight cases.

Cyanosis of the leg in a few cases, sometimes a discoloration along the superficial veins.

Chill in three cases.

Leukocytosis in four cases (11800, 16200, 18400, 28400).

Echymosis in one case.

Local heat and redness mentioned in a few cases.

Rise of temperature, probably caused from the thrombo-phlebitis occurred in fifty-eight cases: Temperature 101-103 in nine cases, 100-101 in nineteen cases and 99-100 in thirty cases, lasting:

	1 day in 2 cases
	2 days " 4 "
	3 " " 4 "
	4 " " 7 "
	5 " " 10 "
	6 " " 4 "
	7 " " 6 "
	8 " " 2 "
	9 " " 2 "
	10 " " 4 "
	14 " " 3 "
more than	14 " " 2 "

In some of these cases it is difficult to exclude the influence on the temperature from other complications, occurring simultaneously, such as wound infections in seven cases and sero-purulent drainage in five cases of the seven, and pulmonary or pleural trouble in ten cases. In thirty of the fifty-eight no other reason was seen that might account for the rise in temperature.

Operations

The following operations were performed on the patients in the

Mayo Clinic:

Abdominal hysterectomy

28 cases

Sub-total hysterectomy 14 cases,
(eleven of whom had at the same time bilateral or unilateral salpingectomy or salpingo-oophorectomy, and three had appendectomy).

Total hysterectomy 14 cases,
(twelve of whom had salpingo-oophorectomy at the same operation and nine had appendectomy).

Myomectomy

2 cases

(one of them also had right salpingectomy and oophorectomy and appendectomy; the other appendectomy)

Salpingectomy

1 case

(Thus there were twenty-five cases of salpingectomy or salpingectomy and oophorectomy. Of these sixteen were bilateral. In these cases the thrombosis was on the right side in three cases, on the left side in ten cases and on both sides in three cases.

Three cases were right salpingectomies. The thrombosis in these cases was on the right side in one case, on both sides in one case and side not mentioned in one case.

Six cases were left salpingectomies. The thrombosis occurred on the right side in three cases, on the left side in one case and on both sides in two cases.

From this small number of cases there does not seem to be any definite relation between the side of the operation and the side on which the thrombophlebitis occurred.

Cholecystectomy	16 cases
(Appendix removed in twelve of these cases; choledochotomy done in two; excision of duodenal ulcer in one.)	
Excision of duodenal ulcer and appendectomy.	1 case
Excision of gastric ulcer and gastro-enterostomy	1 case
Gastro-enterostomy and appendectomy.	1 case
Partial gastrectomy (appendectomy in one case).	5 cases
Appendectomy (nothing else done)	2 cases
(one gangrenous appendix with purulent peritonitis).	
Abdominal exploration.	2 cases.
Paracentesis abdominis and appendectomy (tuberculosis)	1 case
Peter Moseovitz' operation for prolapse of rectum, appendectomy and intraperitoneal shortening of the round ligaments.	1 case
Dilatation and curettement.	2 cases
Dilatation and curettement and operation for inguinal hernia.	1 case
Dilatation and curettement, cautery to cervix, appendectomy and intraperitoneal shortening of round ligaments.	1 case
Dilatation and curettement, perineorrhaphy, trachelorrhaphy and external Alexander operation.	1 case
Dilatation and curettement and removal of cervical polyp.	1 case
Intraperitoneal shortening of round ligaments, appendectomy, operation for umbilical hernia, amputation of cervix and perineorrhaphy.	1 case
Perineorrhaphy and Bovee operation for cystocele (one of them also ventrofixation).	2 cases
Packed for threatening abortion.	1 case
Vaginal hysterectomy (three of them also perineorrhaphy).	5 cases
Mikulicz' operation for carcinoma of sigmoid.	1 case
Colostomy	1 case
Posterior excision of rectum (one of them also colostomy; one had a colostomy as a secondary operation).	3 cases
Resection of bladder for carcinoma.	1 case
Suprapubic prostatectomy.	4 cases
Nephrectomy.	1 case
Pelvic- (nephro-) tomy	1 case
Exploration of kidney (needling troicart)	1 case
Uretero-pelvic plastic	1 case
(After cystoscopic examination)	1 case)

Hernia operations	
-Ventral hernia.	1 case
-Umbilical hernia, and ileostomy three days later. (postoperative ileus).	1 case
-Inguinal hernia.	2 cases
-Bilateral inguinal hernial appendectomy	1 case
-Inguinal hernia, hydrocele operation and appendectomy.	1 case
Thyroidectomy for multiple adenomata in colloid goiter. (one also inguinal hernia).	2 cases
Radical amputation of breast for carcinoma.	3 cases
Operation for varicose veins.	1 case
Amputation of leg	1 case
Exploration of chronic osteomyelitis	1 case
Manipulation and reduction of fractured hip	1 case
	<hr/>
	106 cases.

One striking feature about this table besides the large number of gynecological cases is the very few cases of thrombo-phlebitis after a gastroenterostomy, an operation done very commonly in the Clinic. This might have something to do with the little handling of the tissues during this operation, most of the work being done outside the abdominal wall under very slight tension, or it might be due to the comparatively younger age of most of the ulcer patients.

On the other hand there were a number of cases among outpatients operated for gallbladder disease, most of whom were over forty years of age. That they are usually well nourished supports the supposition that corpulency might predispose for this complication.

Of the cases in which the appendix was removed, usually secondarily, twelve had the thrombosis on the right side, thirteen on the left side and seven on both sides.

Of the operations for inguinal hernia two were done on the right side, one of whom had thrombosis on both sides and one on the right side; one operation was done on the left side and there developed thrombo-phlebitis on the right side; one operation was done for bilateral hernia and thrombosis developed on the left side.

As one would expect from the age of the majority of the patients, a large proportion of the operations (twenty-two of our 106 cases, or 20.8 per cent) was for malignant diseases.

That several of the patients before operation were considered to be in a serious condition for different reasons as objects for an operation, can be seen from the following figures showing the operative risk indicated for many of the cases before operation, judging the operative mortality under the circumstances present for the different patients:

Percentage risk:

1 per cent	- 6 cases
1 $\frac{1}{2}$ "	" - 1 case
2 "	" - 8 cases
3 "	" - 10 cases
4 "	" - 2 cases
5 "	" - 4 cases
6 "	" - 1 case
10 "	" - 2 cases
20 "	" - 1 case

Convalescence

The convalescence of the patients with postoperative thrombo-phlebitis is of interest, especially with the danger of pulmonary embolism in view.

Many of our patients showed a slow convalescence, several of them (about twenty) having reported by letter "weakness", "stiffness", "aching" of the feet, "pain" or "rheumatism" of the leg; "swelling" of the leg, edema of ankle, especially after walking, for two, four, six or more months. In one case an ulcer of the leg appeared seven months after the operation, the leg having been painful and tender all the time since the thrombo-phlebitis began.

Pulmonary Embolism.

The most dreaded end-result after thrombo-phlebitis is pulmonary embolism. Fehling states that he saw embolism in 10 per cent, or perhaps less.

of the cases of thrombo-phlebitis, usually coming on the sixth to sixteenth day, seldom after the third week. After laparatomies he gives the percentage of embolism as 0.86.

Luberasch found 59 per cent of embolism in 584 post-mortem examinations of cases of thrombosis.

In trying to find out the relationship of thrombo-phlebitis to pulmonary embolism in our cases we again have to acknowledge the difficulty in making a correct diagnosis.

While, as previously mentioned, many cases of sudden postoperative death from other causes will be mistaken for pulmonary embolism, it does seem pretty sure that pulmonary embolism is considerably more frequent than it is diagnosed, and that many cases of minor postoperative lung complications really are caused from smaller emboli, which find their way deep into the lung tissues and often give origin to the so-called "embolic pleuro-pneumonia", the latter characterized especially by the symptoms from the involvement of the pleura rather than other forms of pneumonia (Capelle).

In our ninety-six cases of diagnosed postoperative thrombo-phlebitis pulmonary complications were noted as follows:

Number	Chest complication.	Day of onset of same.	Day of onset of thrombo-phlebitis.
89120	Lobar pneumonia (before the thrombo-phlebitis)	?	9th day
68854	Pain left side chest with "tightness"	15th day	7th day
260726	Pleurisy	15th "	13th "
339149	Pleurisy	?	?
332740	Pleurisy	?	10th "
304280	Broncho-pneumonia	2nd "	11th "
117981	Rheumatism left shoulder, sudden pain left costal margin, no cough, examination negative	?	12th "
339021	Pulmonary embolism	16th "	16th "
320155	Bilateral broncho-pneumonia (also septicemia).	52nd "	13th "
314666	Pulmonary embolism	21st "	7th "
309488	Pleurisy	12th "	15th "

Number	Chest complication	Day of onset of same	Day of onset of thrombo-phlebitis.
303763	Sudden sharp pain in precordium; catching on inspiration, pulmon- ary embolism 90 per cent	29th day	13th day
301615	Broncho-pneumonia, pleurisy	13th "	11th "
293947	Pain right side chest; painful deep inspiration; examination nega- tive	31st "	9th "
291012	1) Pulmonary embolism 2) Lobar pneumonia	7th " 18th "	25th "
317356	Chill, fever; heavy feeling in chest; no cough; examination negative	27th "	20th "
258811	1) Hemorrhage from perforation of aneurysm 2) Pulmonary embolism	16th "	15th "

We thus see, that in our cases of diagnosed thrombo-phlebitis pulmonary embolism occurred at least in five or six cases while several others were questionable and had symptoms that might have been caused by a minor embolus but was not diagnosed as such.

On the other side fourteen of our forty-eight cases of pulmonary embolism had postoperative thrombo-phlebitis of veins of the pelvic or the lower extremities, only five of which were diagnosed while the patients were alive; the other nine first shown as marked post-mortem findings. One of our cases was especially interesting on account of the tendency of the embolism to recur. At first having had a marked thrombo-phlebitis she later had repeated severe attacks of pulmonary embolism during the following one and one-half years, usually six to eight weeks apart; she recovered eventually.

Treatment

In the treatment of postoperative thrombo-phlebitis considerable weight has lately been put on prophylaxis.

A limitation of the causes for this complication has been carried out by getting the patients in as good condition as possible before the operation, for instance by treatment of varicose veins, reducing the weight of the patients,

if they are obese, but with no unnecessary starvation shortly before the operation, giving the patients large amounts of fluid for a couple of days before the operation, no heavy catharsis, strengthening the heart if indicated (eventually digitalis, camphor, caffeine).

Different chemical substances (citric acid, calcium, sugar) have been tried in the purpose of lowering the coagulability of the blood but do not seem of much practical importance.

During the operation a good operating technic is essential, exact ligation of vessels, avoidance of every step that might be supposed to cause thrombo-phlebitis, avoiding all kinds of trauma (careful handling of tissues), packing (tamponade), local injections, and, not the least, avoiding infections and working in infected tissues.

Much has been written about the measures provided for after the operation and especially has the advantage of getting the patients to move around early been pointed out. They are urged to lie on the side and to exercise their limbs very soon. The bowels are brought to move earlier than it formerly was routine after operations; the patients are urged to empty the bladder regularly and to take large amounts of water during the first days after the operation. Then they are let out of bed early. In the Mayo Clinic laparotomy patients usually get up on the sixth or seventh day unless conditions would make this inadvisable.

Statistics seem to justify these measures. Kümmell had 610 laparatomies during 1906-07 with 0.99 per cent fatal pulmonary embolism. After letting the patients up early (1908) he had 600 laparatomies with 0.12 per cent fatal embolism.

Kronig's figures after having started "exercise therapy" are 2265 laparatomies with 0.6 per cent femoral thrombosis and 0.1 per cent fatal embolism.

The treatment of the thrombo-phlebitis itself is simple: The patient is kept quiet in bed with the leg elevated, in the beginning ice-bag to the groin and later heat to the whole leg to improve the circulation. After getting up the patient ought to use an elastic stocking or bandage for a couple of months.

In cases of septic thrombo-phlebitis surgical treatment might come into play, for instance incision of phlegmon, sometimes ligation of superficial veins (saphena).

The treatment of the complication of pulmonary embolism has usually been expectative; aside from keeping the patient as comfortable and quiet as possible (morphium), one seems unable to do much of any benefit.

With the hopelessness of every former treatment in mind much has lately been written about an operative procedure for this condition. "Trendelenburg's operation", aiming at the removal of the embolus from the pulmonary artery, has also been tried out several times. Such a method means a last desperate effort and is consequently not followed by very brilliant results and most of the cases died on the operating table. When we remember that 50 per cent of the fatal cases of pulmonary embolism die within ten minutes (C.H. Mayo) that it usually would take ten minutes and more to get ready for the operation and that many seemingly desperate cases conservatively treated have got well in spite of any prophecy to the contrary, and when we remember the possibility of a mistaken diagnosis (of Capelle's twenty-six cases of clinically diagnosed large emboli nine appeared at post-mortem examination to have had a wrong diagnosis), then to most of the "not brilliant but careful surgeons" it would probably seem only fair to the patient to let him have his chance without this operation.