Reflections on Spontaneous Venous Thrombosis and Thromboembolic Disease in the Light of 849 Consecutive Pulmonary Operations*

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VENOUS THROMBOSIS HAS BEEN A CONTROVERSIAL SUBJECT SINCE JOHN HUNTER, IN 1786, AND JEAN CRUEVILHIER, SOME 50 YEARS LATER, ENUNCIATED THE DOCTRINE THAT "PHLEBITIS DOMINATES ALL PATHOLOGY." VICTOR, IN 1846, AIDED BY STUDY WITH THE MICROSCOPE, STATED THAT THE PREDISPOSING CONDITIONS TO VENOUS THROMBOSIS WERE: "INFLAMMATORY OR DEGENERATIVE CHANGES IN THE VESSEL WALL, CHEMICAL OR PHYSICAL CHANGES IN THE COMPOSITION OF THE BLOOD, OR ALTERATIONS IN THE RATE OF FLOW."10 These unchallenged concepts have led to the maxim, "normal blood flowing through normal veins at a normal rate of speed does not ordinarily clot."11 We believe that these postulates actually have little basis of fact, although they have been accepted without question or intensive research since they were first enunciated.

This study of 849 consecutive pulmonary operations showed that although the predisposing factors which are currently thought to be provocative in causing venous thrombosis were present. Actually they caused no greater incidence of the complication than occurs in other types of surgery and much less than in some.

PATHOGENESIS

Careful scrutiny of world literature does not yield any concrete evidence for the cause, or causes, of this complication. The following factors are mentioned frequently as playing a dominant role:

A. Advanced age, because of its relation to general atherosclerosis and the concomitant phlebothrombosis is said to be a prime factor, but this has not been true in our patients. The average age in our series was 39 years; however, many of our patients were well over 70 and venous thrombosis did not occur in this group.

B. Venous stasis heads the list of supposed causes for this complication. McLachlin and his associates12 are of the opinion that venous thrombosis occurs because of stagnation in venous saccules. They, therefore, advise tilting the operating table 15° and encourage voluntary movements by the patients. This has not been our practice. We have not ambulated our patients actively until after the third or fourth day, because of the presence of intercostal drainage tubes, nor have we tilted the bed following operations.

C. Hypovolemic shock is thought to play an important role in the pathogenesis of venous thrombosis.13 We have not encountered it as a causative factor, although it has been our practice to avoid hypovolemic shock as far as possible by the standard practice of replacing blood as it is lost. Non-cellular fluid loss also was promptly replaced to provide proper hydration of the patient.

D. Embolic disease may be caused by tissue other than blood elements. McKeeown14 has noted bone marrow in lung tissue after pneumonectomy and lobectomy, and ten of 17 specimens showed fat embolism. This finding, she believes, may be related to the rib resections. However, she stated that some fat embolism was also found in non-traumatic or operative cases. We have done rib resections in many patients over 40 years of age, where there was difficulty in getting adequate exposure, but we have never encountered this phenomenon after any of our pulmonary operations.

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E. Bed rest and its relationship to venous thrombosis has been discussed widely in most papers we have reviewed. However, there is little proof that bed rest in itself plays too great a role. If venous stasis were the cause of venous thrombosis, patients having long periods of bed rest certainly should have a greater incidence than those who are not forced to be in bed; but thrombosis is no more common in paraplegics or in quadriplegics than among patients who are ambulatory. Also, our studies show that pulmonary embolism is infrequent in tuberculous patients treated by bed rest. In Sunnyside Sanatorium, during the 14 years covered by this survey, a total of 2685 patients were admitted. Only one case of thrombophlebitis occurred in patients on medical treatment, and only one case was found in patients who had undergone pulmonary surgery for tuberculosis. The patient who developed thrombophlebitis on the medical service was pregnant, and the complication occurred postpartum.

F. Minor blood transfusion reactions and incompatibilities as a cause for thrombosis have been mentioned repeatedly. However, here again, although we have had some transfusion reactions, they were not followed by this complication in any case.

G. Surgery. Thrombolism has been said to be more common in postoperative cases, but our experience does not bear out this assertion. The complication occurs in comparable numbers in both operative and nonoperative cases, and often it occurs spontaneously in ambulatory patients.

H. Seasonal variations have been mentioned as influences for venous clotting, but the seasons involved are not always uniform and our own experience bears this out.

Clinical Material

We have recently completed a review of 849 consecutive pulmonary operations performed by one of us (JKB) in various Indianapolis hospitals during the 14-year period, 1947—1960. The survey included medical and surgical data pertaining to each patient receiving pulmonary surgery. We were seeking to learn among other information whether any one factor, or group of factors, could be isolated as progenitors or precursors of venous thrombosis in the medically or surgically treated cases.

Our pre- and postoperative care conformed in most areas to standard practice. There were perhaps a few outstanding differences which should be mentioned.

Tracheal aspirations were found necessary at times, but bronchoscopy was used only rarely.

Oxygen inhalation was employed rarely. We have felt that oxygen therapy is necessary at times when cyanosis is present and the airways are clear, but that oxygen in itself is not entirely without danger.

Tracheostomy was necessary in only five cases in the entire series, but was never withheld when it was felt to be indicated. All five of the patients requiring tracheostomy were cases with borderline respiratory function, and we felt that the tracheostomy provided for a better toilet of the tracheobronchial tree, thereby reducing the work necessary to overcome the elastic recoil of the lungs and the flow resistance of the bronchial lumina. None of our patients received anticoagulant drugs. We believe, as do others, that with the exception of heparin used for long periods, they have little value unless large, even dangerous, doses are used.

Figure 1: Photograph of intercostal tube used for underwater seal drainage (amber pure gum rubber surgical tubing 3/16 in. diameter x 3/32 in. thickness, Davol).
SPONTANEOUS VENOUS THROMBOSIS

INCIDENCE OF VENOUS THROMBOSIS AND THROMBOEMBOLISM IN 849 CONSECUTIVE PULMONARY OPERATIONS, 1947 to 1959

<table>
<thead>
<tr>
<th>Age Limits</th>
<th>Avg. Age</th>
<th>Sex</th>
<th>Iliofemoral Thrombophlebitis</th>
<th>With Thromboembolism</th>
<th>Mortality Thromboembolism %</th>
<th>Overall Mortality % due to Thromboembolism</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 yr. to 75</td>
<td>39</td>
<td>503</td>
<td>346</td>
<td>2</td>
<td>0.35%</td>
<td>0.23%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(59.2%)</td>
<td>(40.8%)</td>
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</tbody>
</table>

**Figure 2:** The overall incidence of venous thrombosis was 0.35 per cent. The occurrence of thromboembolism was actually 0.235 per cent and the mortality from thromboembolism was 0.117 per cent. The mortality from all causes was 4.6 per cent. (One of those deaths was due to thromboembolism 2.6 per cent of the overall mortality).

Borgström believes in early ambulation. He found no difference between the incidence in those who did, or did not, receive anticoagulants, provided the patient was allowed to walk early and was under the age of 45.

We ordinarily use two large tubes for underwater seal drainage, which are easily removed (Fig. 1), placing one anteriorly and the other laterally, and connecting them to the underwater seal bottles with suction. This is done so that minimum time will be required to induce re-expansion of the lungs, and so that the tubes may be removed within 48 to 72 hours following surgery. This permits us to use less narcotic medication than would otherwise be necessary.

**DATA ON VENOUS THROMBOSIS and THROMBOEMBOLISM IN 849 CONSECUTIVE PULMONARY OPERATIONS, 1947 to 1959**

<table>
<thead>
<tr>
<th>OPERATION</th>
<th>NUMBER OF CASES</th>
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<tbody>
<tr>
<td>LOBECTOMY, One or more lobes or segments</td>
<td>346 (1.035%)</td>
</tr>
<tr>
<td>PNEUMONECTOMY</td>
<td>312 (1.032%)</td>
</tr>
<tr>
<td>SEGMENTAL RESECTION One or more</td>
<td>62 (1.031%)</td>
</tr>
<tr>
<td>WEDGE RESECTION One or more</td>
<td>49</td>
</tr>
<tr>
<td>DECORTICATION</td>
<td>45</td>
</tr>
<tr>
<td>EXPLORATION and WEDGE</td>
<td>12</td>
</tr>
<tr>
<td>EXPLORATION and SUTURE</td>
<td>10</td>
</tr>
<tr>
<td>EXPLORATION and BIOPSY</td>
<td>6</td>
</tr>
<tr>
<td>LOBECTOMY and THORACOPLASTY</td>
<td>5</td>
</tr>
</tbody>
</table>

* 36 Patients had more than one procedure

**Figure 3:** Thromboembolism and venous thrombosis following various types of pulmonary surgery. It occurred once after lobectomy without thoracoplasty (0.284 per cent) and once after pneumonectomy (0.320 per cent). Venous thrombosis without embolism occurred once after segmental resection (1.61 per cent), highest percentagewise, but not statistically significant.
We instruct our nurses and patients in the art of less painful, less terrorizing tussic actions. This is important.

None of our patients with venous thrombosis had vein ligations. The wisdom of interference with venous return by prophylactic or therapeutic ligations of major venous trunks is open to question and may even be harmful.

The routines in which we varied are perhaps minor and played no role in the paucity of venous complications in this series of cases. However, we were gratified to learn that only three patients in the entire series of 849 consecutive pulmonary operations had venous complications (0.35 per cent) (Fig. 2).

We noted that venous thrombosis appeared once with thromboembolism after 351 lobectomies including those with thoracoplasty (0.28 per cent), once with thromboembolism after 312 pneumonectomies (0.32 per cent), and once after 62 segmental resections without thromboembolism (1.6 per cent) (Fig. 3). Venous thrombosis did not seem to have any predilection for one disease over another. It occurred only once in tuberculosis, once in carcinoma, and once in bronchiectasis, although percentagewise its incidence was greatest after surgery for bronchiectasis (Fig. 4).

**DISCUSSION**

We have reviewed the literature pertaining to the general incidence of venous thrombosis in surgery. We found only one article in which thromboembolic disease was discussed in patients having pulmonary surgery. The author observed that...
The occurrence of venous thrombosis as reported in world literature has varied only slightly from year to year. The range of fatal thromboembolism following general surgery has been anywhere from 0.01 per cent to 0.87 per cent during the last 50 years. During the last 20 years, it has varied from 0.03 per cent to 0.16 per cent, the average being 0.08 per cent. In the United States, the incidence of venous thrombosis is roughly 0.26 per cent, and it occurs most commonly after gynecologic operations. By way of comparison, in Scandinavian countries the incidence is 0.20 per cent, and the occurrence is most common after biliary operations.

**SUMMARY**

There is no proof that currently held views on the pathogenesis of spontaneous venous thrombosis are accurate. In fact, little has been added to the Virchow postulates of 1846.

In our study of 849 consecutive pulmonary operations we expected to find a greater incidence of venous thrombosis and thromboembolic disease than has been observed in other types of surgery. This was anticipated because of the relatively long period of required bed rest and other factors leading to venous stasis. However, the incidence of venous thrombosis in this series of pulmonary operations was only 0.35 per cent. This is no greater than in other forms of surgery, and much less than in some.

**Acknowledgment**—We are greatly indebted to Basil J. Datzman, M.D., who helped in gathering statistical information in the Sunnyside Sanatorium and Marion County General Hospital.

**References**


MEDIASTINAL PACKING TO CONTROL BLEEDING ESOPHAGEAL VARICES

Total posterior mediastinal packing through a cervical incision offers the benefit of direct control of actively bleeding esophageal varices. This operation is well tolerated, even by the critically ill cirrhotic patient because it is performed under local anesthesia; laparotomy and thoracotomy are avoided; and operating time is less than 30 minutes.

Three patients with far-advanced cirrhosis and actively bleeding varices have been treated by this method. The operation was successful in completely controlling the bleeding in two of the patients and temporarily stopped the hemorrhage in the third. The authors believe this operation is indicated when bleeding from esophageal varices continues or recurs after balloon tamponade has been used for 36 to 48 hours.