POST-OPERATIVE COMPLICATIONS INVOLVING THE BRONCHI, LUNGS, ETC.*

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AMONG the most frequent and serious complications which arise after operations are inflammatory conditions of the bronchi and lungs. The most important of these are bronchitis, pneumonia, pleurisy, acute edema, gangrene and abscess of the lungs, pulmonary emboli, and the lighting up of chronic tuberculous processes.

The rôle played by the anesthetic in the etiology of these diseases has never been definitely determined. Before the discovery of anesthesia lung complications caused a high mortality after operation, and some recent statistics of v. Miculicz and other German writers are extremely interesting as bearing upon the rôle played by ether and chloroform in the causation of such complications. Miculicz (*Centralbl. f. Chir.*, 1901, No. 29, p. 16) states that at the Breslau Clinic in 1,005 laparotomies and operations for strumous affections under general anesthesia, there was a pneumonic morbidity of 7.5 per cent. with a mortality of 3.4 per cent. In 272 cases operated upon under local anesthesia (Schleich's method) there was a morbidity of 12.8 per cent. and a mortality of 4.8 per cent. due to pneumonia. This increase, he thinks, was due to the nature of the operation and of the disease from which the patient was suffering, his cases where local anesthesia was employed being from the outset more prone to lung affections than those where ether or chloroform was used. There are other statistics which are equally as striking, and they all emphasize the fact that a large proportion of the more serious lung complications after operations are not due to the action of the anesthetic.

I have been unable to find satisfactory statistics as to the frequency of pulmonary and bronchial complications in general after operations. In approximately 8,000 to 9,000 cases of general anesthesia, of which over 7,000 were operations, in the gynecological department of the Johns Hopkins prior to 1901, there were 17 cases of pneumonia, 18 of bronchitis without

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other lung affection, 16 of pleurisy, 6 of recognized pulmonary embolism, and one case of gangrene of the lungs. These statistics, while not extremely accurate, are as much so as statistics of the kind can be. It is not possible to always recognize the exact lesion in cases of the kind which recover, and many of those who die do not come to autopsy. In most of these cases the diagnosis, was made after consultation with experts in physical diagnosis, and the symptoms, as stated in the notes, have been carefully compared with the diagnosis. Where autopsies took place the anatomical diagnosis was taken. According to the above statistics pneumonia occurred once in every 523 cases of general anesthesia; pleurisy, once in every 566 cases; bronchitis, once in 500; and pulmonary embolism, once in every 1,333 cases. Gerulanos (*Deutsche Zeitschr. f. Chir.*, 1900, Bd. LVII., p. 361) states that in the surgical clinic at Kiel, 7 of 95 deaths occurring after operations were due directly to lung complications.

There are some observations which apply more or less to all of the post-operative lung complications. The immediate effects of the anesthetic, especially ether, upon the mucous membrane of the air passages is doubtless largely responsible for many cases of bronchitis and edema of the lung. Lindemann (cited by Gerulanos and Hölscher (*Archiv. f. klin. Chir.*, Bd. LVII, p. 175) however, could not find in their experiments upon animals that ether ever produced an inflammatory action upon the lung itself. Chilling or catching cold, either through exposure in a cool operating room or after leaving a heated operating room and returning to a cold ward, is in many cases responsible for the pulmonary affection. Hölscher estimates that a patient loses from .1° c. to 3° c. of heat during anesthesia according to the length of time and the condition of the patient. Weak and feverish patients according to him lose more than strong and robust ones. This loss of heat would render the patient liable to pneumonia, bronchitis, etc., unless great care were taken to protect her from exposure to cold. The aspiration of mucus, vomitus, and saliva with the bacteria of the mouth and pharynx are responsible for many cases of affection of the lungs, bronchi, etc., which occur after operation. The congestion of the lungs caused by weak circulation; the recumbent posture; and the want of proper expansion of the chest and aeration of the lungs due to weakness, pain, tight bandaging, and distended intestines, prepares the ground for the infection. The excitement before the operation,

with the anxiety and unrest not only cause the patient to take the anesthetic worse than she otherwise would, but by producing a generally depressed condition render her more susceptible to other influences, such as cold. The amount and character of the anesthetic, the skill with which it is given, and the time of anesthesia play important parts. Alcoholic, fat, and plethoric patients require more of the anesthetic and are more apt to suffer with lung complications. The nature of the operation seems to play an important rôle in the causation of lung affections, certain operations as those for strangulated hern a being more apt to be followed by pneumonia. and those for myomata, etc., by pulmonary embolism. The frequency and importance of the smaller pulmonary emboli which do not cause instant death are underestimated by most observers, many of the post-operative pulmonary affections being of embolic origin.

Pneumonia.—The frequency of the occurrence of pneumonia apparently varies in different countries and in different clinics in the same country. This difference may be partly real but is in greater part only apparent. The difficulty in getting reliable statistics is obvious. It is not always possible to differentiate small bronchopneumonic areas from localized tuberculous processes, hemorrhagic infarcts, etc., and cases come to autopsy with post-operative pneumonia when the condition was not recognized during life. In this country a great many cases who die never come to autopsy, and we have to depend upon a clinical diagnosis. The number of the cases of pneumonia following operation depends also upon the nature of the operation, the methods of operating, the country, the season of the year, the anesthetic employed, *and the manner in which it is given.* Anders (*Univ. Med. Mag.*, Phila., 1897–8, X, 611) found in 12,842 cases of ether narcosis in Philadelphia 30 cases of pneumonia and 13 deaths. Prescott (cited by Osler) in Boston in 40,000 similar cases found only 3 cases of acute lobar pneumonia. Henle (*Centralbl. f. Chir.*, 1901, No. 29, p. 74), in von Miculicz's Clinic in Breslau, reports in 1787 cases of laparotomy and operations for hernia, 143 post-operative pneumonias with 65 deaths, and in 200 amputations of the breast, 2 pneumonias and one death. In 8,000–9,000 cases of anesthesia, representing 7,000 operations in the gynecological clinic of the Johns Hopkins Hospital there have been 17 cases of pneumonia.

The relative frequency of lobar and bronchopneumonia seems generally in favor of the latter.

In Henle's cases, of those which came to autopsy 7 were acute lobar pneumonia, 24 lobular or bronchopneumonia, and 17 pulmonary gangrene. In Gerulanos' 7 cases, 5 were bronchopneumonia, one gangrene, and one a pulmonary infarct. In 17 cases of Bloodgood, reported by Osler, 13 were bronchopneumonias and 3 lobar pneumonias. Kümmell (*Centralbl. f. Chir.*, 1901, No. 29, p. 78) reports 1070 laparotomies with 8 lobar and 21 bronchopneumonias. In our patients 9 were lobar, and 8 bronchopneumonias, one of the latter finally becoming gangrene.

The causes of pneumonia following operation may be divided into the predisposing and the exciting. The predisposing causes are old age; intemperance; weakness or disease of the heart, and blood vessels, and diseases of the kidneys; the recumbent posture; the inability to cough up foreign substances and the imperfect expansion of the lungs on account of pain, distension of the intestines, tight bandaging, coma, and the use of narcotics; edema of the lungs caused by the anesthetic; excitement, shock, etc.; preexisting disease of the bronchi, nose or mouth; chilling of the body during or after operation; and the presence of foreign substances such as mucus and vomitus. The exciting cause is bacteria, which gain access by aspiration of foreign substances and through the blood and lymph channels. Infected emboli may carry the bacteria or the latter may gain access through the blood and lymph vessels without the aid of the former. The bacteria which are found to be the cause of post-operative pneumonia are the micrococcus lanceolatus, the pyogenetic cocci, the bacillus coli communis, the bacillus pneumoniæ of Friedländer, and others.

In our cases age and season of the year did not seem to play important parts in the causation of the disease. The nature of the operation seemed more important, most of the cases having followed serious laparotomies.

Symptoms.—In the cases of *lobar pneumonia* the symptoms, as a rule, appeared a short time after operation, some within 12 hours. The disease usually ran a typical course, beginning with a chill. There was a sudden rise of temperature to 104° F.–105° F.; rapid pulse; cough with the characteristic sputum; pain in the chest, dyspnea or hurried respirations, and the disease usually ended by crisis. The physical signs were usually unmistakable. The symptoms of *bronchopneumonia* were not so definite. In these cases the symptoms came on later and it was generally several days before a diagnosis could be made

with any degree of certainty. The temperature was not so high and was somewhat irregular in its nature, there was generally bronchitis, cough, frequently blood-stained sputum, and rather indefinite physical signs. The cases, as a rule, ended by lysis.

Treatment.—The prophylactic treatment will alone be considered. The two things of most importance are the proper administration of the anesthetic and guarding the patient against chilling. In most cases it is possible, by proper administration of the anesthetic, to prevent the collection and aspiration of mucus, vomitus, etc. She should be protected against loss of heat by a properly heated operating room and ward, the protection of the intestine by means of warm gauze, and having her body well protected, both during operation and afterwards. Some surgeons employ operating table which are heated, and claim by their use to have lessened their mortality. Rapidity in operating, proper skill and care in the administration of and the reduction to the smallest possible quantity the amount of the anesthetic are very important. In cases of strangulated hernia, and where the patient is very weak or has chronic disease of the bronchi and lungs, local anesthesia is indicated. In the more serious operations, especially with nervous, excitable women, general anesthesia is nearly always necessary. Where the stomach is full it is well to wash it out before operation. Cleansing the mouth, throat, etc., is probably of little value. The administration of a small hypodermic injection of morphine and atropine a short time before the operation tends to put the patient in a more quiet frame of mind and to lessen the amount of secretion from the mouth, etc. After operation the patient should be frequently turned in bed, the bandaging should not constrict the abdomen or chest, she should be encouraged to breathe deeply, and to cough up any material which had been taken into the lungs by aspiration.

Pulmonary Embolism. According to my statistics, pulmonary embolism was recognized only six times in between 7000–8000 gynecological operations of all kinds. As I will show when considering "pleurisy" the occurrence of small emboli is probably much more frequent than the figures given would indicate. The principal sources of pulmonary embolism followed gynecological operations are the ovarian and branches of the common iliac veins. There seems to be a special liability for pulmonary embolism to follow operations for uterine fibro-myomata, ovarian tumors, carcinoma uteri, large incarcerated hernias. Also a num-

ber of cases have been reported following operations upon the kidneys. The embolism generally takes place between the first and the fourth week after the formation of the thrombus, although it occurs, at times, within a few days after operation and occasionally later than the fourth week.

In a considerable proportion of the cases of pulmonary embolism the thrombi exist at the time of operation, and the embolus is set free either by manipulation at the operation or by removal of the pressure on the veins. In a case seen in Zweifel's Clinic the fatal pulmonary embolus coming from the femoral vein followed the drainage of an abscess in the right iliac region.

The symptoms of a pulmonary embolus depend upon the size of the vessel which is obstructed, the rapidity and completeness of the obstruction, the nature of the embolus, and the general condition of the heart, lungs, etc., of the patient. When the embolus is large and the pulmonary artery, its chief branches or it may be when one of them is plugged, death may be instantaneous or ensue in a few minutes. Usually the patient gives a sharp cry, sits up suddenly in bed, complains of great precardial distress, and gasps for breath. The auxiliary muscles of respiration stand out prominently, the cervical veins are distended, and the patient shows marked signs of collapse. The heart's action may be tumultuous or slower than normal. It is generally weak and irregular. The pulse varies greatly being, in some cases, slow, full and irregular, in others almost imperceptible at the wrist. There is pallor, followed by cyanosis. One, at times, sees convulsions and opisthotonos. The patient usually dies in a state of coma. The physical signs do not indicate the lesion, the full stridulous breath sounds being usually the only thing brought out on examination of the chest. When the embolus does not totally occlude the vessel or vessels the patient may live several hours and die as a result of a secondary thrombus. In such a case the same symptoms are seen, only they are not so pronounced as in the rapidly fatal cases. In one of our fatal cases the symptoms grew less marked for a few hours and an examination of the chest showed stridulous breathing and a tumultuous heart's action only. She died at the end of 12 hours. Cases have been reported where the patient lived several days after the occurrence of the embolism. When a small vessel is plugged there results usually a hemorrhagic infarction of a limited extent. The occurrence of the infarction is indicated by sharp pain in the chest, chilly sensations, dyspnea, and

pleurisy. Blood-stained sputum is frequently seen and profuse hemopytsis is occasionally present. Examination of the lungs may show changes but the diagnosis can not be made in most cases by means of it, as it is generally impossible to differentiate these cases from other affections of the lungs which follow operations. Even after grave symptoms have arisen in pulmonary embolism the patient may recover. If the embolus is infected, the effects and symptoms are those of bland emboli to which are superadded the specific effects of the bacteria with which they are infected, and abscesses, gangrene, etc., may supervene.

The diagnosis is based upon the sudden and characteristic symptoms and the existence of a recognized source of an embolus. In any case where pleurisy of limited extent or evidence of small areas of pulmonary inflammation are seen after operation, the probability of an embolic cause should always be considered.

The treatment is for the most part prophylactic. After the embolism has occurred, very little can be done. Hypodermic injections of camphor or brandy should be used to combat the collapse and if the cyanosis is marked oxygen should be administered. Unfortunately in most cases one suspects nothing until the patient suddenly dies of an embolus from one of the thrombosed pelvic veins. Following operations nurses should be trained not to rub the lower extremities of patients who complain of pain there, without instructions. In cases of post-operative pleurisy, or sudden sharp pain in the chest with rapid and irregular pulse the surgeon should think of embolism and take precautions to prevent any marked or sudden muscular exertion.

Pleurisy.—Acute pleurisy occurring after operation and independent of penumonia and tuberculosis is less frequent than would appear at first sight. Most cases where there is severe pain in the chest accompanied with a pleuritic friction rub and without definite signs of pneumonia are diagnosed pleurisy. In the majority of these cases the pleurisy is secondary to some other process, as hemorrhagic infarct or a small spot of bronchopneumonia. The relation which exists between pleurisy and embolism is strikingly illustrated in our cases. In the 16 cases of so-called pleurisy which have been previously mentioned, in only one was there an effusion, and in more than one-half of them there was either evidence of a thrombus or signs of an embolus.

One case was so typical and shows so plainly the connection

between thrombosis, pulmonary embolism and the so-called post-operative pleurisy that I give it somewhat in detail.

CASE I.—*Hystero-Myomectomy*. Mrs. C.—Operation, May 11, 1895. No complications.

May 18th.—Sudden attack of sharp pain over a localized area in the left chest. This was increased by deep inspiration. Temperature 103° F., pulse 104, dry cough. Physical examination showed a pleuritic friction sound in region of pain, the other signs being indefinite. The pain decreased and the signs of pleurisy had disappeared by May 24th.

May 29th.—While using a bed pan she was suddenly seized with a fainting spell and complained of a feeling of oppression over the sternum.

The physical examination of the chest was negative. Pulse, 120, feeble. Her symptoms increased and in a few hours she was suffering from dyspnea, a heavy aching pain over the sternum, ringing in the ears and dark spots before the eyes, cold and clammy extremities. The pulse was 140 and the heart's action tumultuous. (Under a mistaken diagnosis of hemorrhage, an exploratory laparotomy was performed, but nothing was found to account for the symptoms.)

May 30th.—Patient better. Pain in chest continues. Pulse 120. Pain is complained of in left leg.

May 31st.—Well marked symptoms of phlebitis in left leg.

June 7th.—Phlebitis in right leg.

The patient eventually recovered. In this case there was probably a thrombus in one of the pelvic veins which extended to the iliac veins and finally caused the so-called phlebitis. The attack of supposed pleurisy was undoubtedly an infarct from a small embolus and the second attack a typical one of pulmonary embolus which probably partially plugged a larger vessel.

The following are some of the cases of pleurisy which also show the same relationship:

CASE II.—Phlebitis followed in 7 days by pleurisy.

CASE III.—Signs of pleurisy with a plebitis on the following day.

CASE IV.—Phlebitis followed in one month by pleurisy (localized).

CASE V.—Pleurisy on 10th day. Edema of legs on 16th and 17th day respectively.

CASE VI.—Phlebitis on 23d day and pleurisy on 28th day after operation.

CASE VII.—Pleurisy with signs of pulmonary embolism with sudden dyspnea, cyanosis, rapid pulse, cold extremities.

CASE VIII.—Pleurisy (?) developed 11 days after operation. This gradually cleared up and on 27th day, as she was leaving the hospital, she fell over and expired. No autopsy allowed, but the diagnosis was "pulmonary embolus."

A certain number of cases of pleurisy are tuberculous in origin, but the proportion of such cases after operation is smaller than in cases which enter the medical wards. Cases of pleurisy arise also which are not due to pneumonic areas in the lung but owing to the fact that nearly all recover it is difficult to estimate the correct proportion of the different varities.

The symptoms and treatment will not be dwelt on here. In a few cases arising in our wards the diagnosis wavered between diaphragmatic pleurisy and gall stones.

Gangrene of the lungs is a rare post-operative complication and is generally the result of aspiration of the vomited material during anesthesia. It may occur from the same cause in very weak or unconscious patients. At times it results from emboli which arise from gangrenous wounds or from the infection of an infarct with the putrefactive bacteria. The symptoms vary considerably and will not be gone into here. The diagnosis is largely based upon the character of the expectoration which is intensely fetid and usually of a greenish color. The German writers apparently meet with it more often than is the case in America. From the statistics given before it seems not an unusual complication in some of their clinics while only one known case has arisen following 8,000 operations in our clinic.

Abscesses of the lungs are even less common than gangrene, except as an accompaniment of pyemia or an extension from some neighboring organ. The causes are the same as gangrene with the absence of the putrefactive bacteria. Hence it is most often found in cases of pyemia and not as the result of an aspiration pneumonia.

Edema of the lungs to a greater or less extent occurs in all forms of intense congestion and inflammation. General edema occurring after operation is stated to have for its causes the direct action of the anesthetic upon the lung and a depression or paralysis of the vasomotor center. Disease of the heart and kidneys is a predisposing cause. The pathology of this affection is not clear. Noble says that since using salt solution freely, and especially since elevating the foot of the bed with the

peritoneal cavity full of this solution that he has had six cases of pulmonary edema. While he does not claim that the edema is due to the posture and use of the saline he thinks the frequent occurrence of edema very suggestive. Overfilling the blood vessels, diluting the blood, and giving the patient a posture which tends to compress the lungs and embarrass the heart, would, theoretically, tend to cause an edematous condition of the lungs. The principle symptoms are dyspnea and cough. The physical signs are indefinite, there being usually defective resonance and large liquid râles over the bases.

In acute cases purgation and venesection are indicated. Cardiac stimulants should be freely used.

Pulmonary tuberculosis as a post-operative affection is not well worked up. The conditions of the lungs which favor its development are generally present after serious operations. Doubtless many cases have had surgical operations as their starting-point, but it would appear that in the more acute tuberculous process is a lighting up of a pre-existing lesion. The encapsulated or quiescent tuberculous nodule becomes the starting point of a more serious lesion. I have seen two cases of acute pulmonary tuberculosis following simply hernia operations. They both came to autopsy within six weeks after the operation.

It is often necessary to operate upon patients who are known to have chronic pulmonary tuberculosis. In these cases local anesthesia should always, where possible, be employed, and when necessary to use chloroform or ether the former is to be chosen.

Acute Bronchitis.—This is one of the most frequent affections of the air passages which follow anesthesia. It generally accompanies pneumonia, but appears also quite frequently as an independent affection. There were 18 cases among our patients which were quite independent of any signs of pneumonia, etc.

The *causes* are the immediate effects of the anesthetic, especially ether; the existence of chronic bronchitis; catching cold during or after operation; and the aspiration of mucus and vomitus during narcosis.

The *symptoms* and *treatment* are those of ordinary bronchitis. The prophylaxis is most important, special attention being given to prevent chilling of the body by a cold operating room or having the patient not sufficiently protected in moving her from the operating room to the ward. The coughing causes pain

in patients having an abdominal incision and the remedies which check the cough are contraindicated to a certain extent as the accumulation of the initiating substances are a frequent cause of bronchopneumonia. The violent coughing has in a few cases caused a separation of the edges of the incision.

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