

SARCOMA OF THE CHEST WALL.*

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OPERATIONS for tumor of the chest wall have always been among the comparative rarities of surgery.

Tumors of the chest wall, ribs, and sternum may be divided into primary tumors: fibroma, chondroma, sarcoma, and their combinations, and secondary tumors: sarcomata and carcinomata.

The primary tumors are of considerably greater interest. The diagnosis is ordinarily very simple, and reduces itself merely to the existence of the tumor. Pathologically they are chondromata, chondrosarcomata, osteosarcomata, or mixed tumors. The growth is always about the same. They appear almost always at about the middle of the thorax (Molimard). In thirty-nine cases in which the position was accurately indicated the tumor was located only three times on the first rib and six times on the second. They are more apt to be located on the sixth, seventh, and eighth ribs. They appear over the rib on either side, and usually involve the rib above and the rib below. In those thirty-nine cases, Molimard found one rib involved only nine times; two ribs, six times; three involved fifteen times; and seven ribs involved four times. While spreading on to the ribs, the tumor mass ordinarily does not attack the skin or the muscles.

For a long time usually the tumor expands first outside the chest, so that the intercostal vessels and nerves are not affected. Occasionally the growth of the tumor inward is attended by great pain due to involvement of the intercostal nerves. At first the nerves are lifted up, but finally both vessels and nerves are surrounded by the tumor. The tumor does not invade the lymphatics, but extends by direct growth

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along the intercostal space toward the sternum and the posterior end of the ribs. Sometimes the vertebral bodies may be attacked without its being seen on the outside. After expanding for a certain length of time on the outside these tumors extend inward and project into the intercostal space. The pleura over them is thickened at first, and finally invaded by the tumor. The visceral pleura is rarely involved because the tumor does not become adherent and extend over to the lung. The lung, as in the cases reported in this paper, may be deeply indented by the tumor without becoming adherent to the pleura. In rare cases, adhesion of the visceral pleura and invasion of the lung does, however, take place. Numerous authors have reported removal of a portion of the lung in the removal of these tumors, among whom may be mentioned Voutier, Tropinow, Sedillot, Helferich, and others. Nevertheless, the direct invasion of the lung by the tumor even when the lung is adherent is rare. Invasion of the pericardium also is rare, but extensions to the diaphragm are more common.

The dangers attendant upon the opening of the pleura in the early days were very great. Of the very few cases reported in literature in the pre-aseptic period, almost all died. If they survived the hemorrhage and shock of a formidable operation with opening of the pleura, they died of infection; and in the early days of the antiseptic method, they began to die of carbolic acid poisoning. Naturally, tumors of the chest wall were allowed to attain a great size before the danger of an operative attack was thought to be justified, and the mortality of the operative cases was high. The shock of operating upon the chest wall is great in proportion to that in other parts of the body: 1. Because of the interference with respiratory rhythm; 2. The nearness of the heart and great vessels; and 3, and most important, to the fact that when the pleura is widely opened there is interference with respiration and circulation on account of the sudden collapse of the lung. The collapse is due to the altered conditions of

pressure. The mediastinum with its great blood-vessels and nerves is deflected to the opposite side,—less in man than in animals, it is true, but enough to be a cause of severe shock.

If these untoward conditions be overcome, there is the danger of infection in the pleural cavity, especially if, as was usually the case when drainage was employed, the lung was left collapsed at the end of the operation so that the closure of the cavity was impossible, and empyema,—bad enough in any case, but worse still when attacking a patient whose lymphatic spaces had been opened up by an extensive and mutilating operation,—was almost certain to follow.

Asepsis, modern instruments, and improved technic have, however, of late years gradually diminished the dangers of hemorrhage and infection; while during the last fifteen years, the improvements in our method of maintaining the expansion of the lung during the operation by positive pressure, Fell O'Dwyer apparatus, the positive and negative pressure cabinets of Sauerbruch, Brauer, and others, culminating in the almost ideal method of intratracheal anæsthesia, have removed the chief dangers of operative interference. The X-ray has enabled us to make an early diagnosis, and tells us whether we must be prepared for an extensive opening in the pleura or not; so that it is now our own fault if we do not deal with these cases better than did our predecessors.

In 1898, F. W. Parham, of New Orleans, published a most thorough and scholarly report of what had been accomplished from the dawn of time in the surgery of the thoracic wall. He had at that time operated upon two tumors of the thoracic wall requiring extensive opening of the thorax, and was obliged in the first case to combat severe shock which instantly supervened when the thorax was opened. In the second case, he employed the Fell O'Dwyer apparatus for inflation of the lungs, and was enabled to prevent collapse of the lung, dispense with irregular respiration and shock, and at the end of the operation, to suture the lung around the margin of the opening in the chest wall so that it was maintained in expansion. In his most thorough and inclusive

article, Parham reports all the cases of surgery of the chest wall in which the pleura had been opened, published up to the time of his own cases,—only fifty-two in number—and analyzes them from every point of view. The chief point of practical interest was the study of the effects of the pleural opening. A small pleural tear quickly controlled by stopping the opening with gauze or other pads was shown to have produced little shock. The presence of adhesions prevented shock by inhibiting collapse of the lung. The wide opening of the pleura, with the sudden entrance of a large current of air, intensified the shock to an extreme degree. The methods by which this had been controlled had been the covering of the pleural opening by the finger, compresses, or suturing; traction of the lung into the opening, stitching the lung into the opening (Tuffier, Beyer, and Parham); substitution of temporary hydrothorax for pneumothorax (Witzel); injection of sterilized air (Lowson); Quenu and Longuet's intra-bronchial tension; O'Dwyer's method, etc. Parham speaks enthusiastically for the Fell O'Dwyer apparatus; yet after his paper was published, various operators (Rixford, Porter, and others) reported cases of tumor of the chest wall successfully performed without special apparatus, in which various rough expedients were adopted to close the opening in the chest. Perhaps this was because the cases were so rare that when they presented themselves few surgeons had the special apparatus at hand.

Then came the important work of Sauerbruch, Brauer, Willy Meyer, Robinson, and others, which provided us with pressure cabinets, the cumbersome nature and expense of which, in proportion to the rarity of the cases in which they were of benefit, precluded their general adoption; and then the intratracheal anæsthesia, which places within the reach of every surgeon a safe and simple apparatus which does everything that the pressure cabinet does and even more safely for the patient. The superior safety of this method lies chiefly in the fact that with the catheter in the larynx and the air current rushing outward around it, neither mucus,

nor blood, nor œdema, nor dropping of the tongue, nor even cessation of the respiratory movements can interfere with the air exchange. The apparatus is useful for so many other conditions beside lung surgery,—neck, tongue, mouth, pharynx, cerebrum, etc.—that it is in almost constant use in large clinics where it is employed at all.

My own excuse for reporting the case which follows is, first, the rarity of these cases; second, the exact pre-operative diagnosis which the X-ray enabled us to make; third, the extreme simplicity of the operation, and the ease with which the lung was kept in expansion with a widely opened thoracic wall; fourth, the fact that I have so far found few reported cases of chest surgery under the intratracheal method in which there were no adhesions, the lung being entirely free; and fifth, that it illustrates the importance of dispensing with drainage in these cases.

S. P., about thirty-three years of age; housework: A tall, delicate, somewhat anæmic woman. Had noticed three years before a tumor under the left arm, which at first was quite small and had recently grown rather fast.

Examination showed that she had hypertrophy of both breasts, and in the right axilla attached to the chest wall was a mass about the size of a baseball. X-ray showed that this mass projected inside the chest (Fig. 1).

At the Corey Hill Hospital, on June 19, 1912, I made a curved incision in the left axilla, starting at the level of the second rib, at the lower border of the latissimus dorsi, carrying it six inches forward on to the breast, then downward about four inches, then backward to a point below the beginning of the incision. On turning this flap backward and dissecting free the pectoralis major and latissimus dorsi from the tumor, I surrounded the tumor, taking great care not to peel the subcutaneous tissue from its surface but leaving it attached. The third, fourth, and fifth ribs were then divided by an osteotome, in front of the tumor, the pleura being widely opened. Then the ribs were divided behind the tumor, and the tumor with about six inches of these ribs removed. The operation was

FIG. 1.



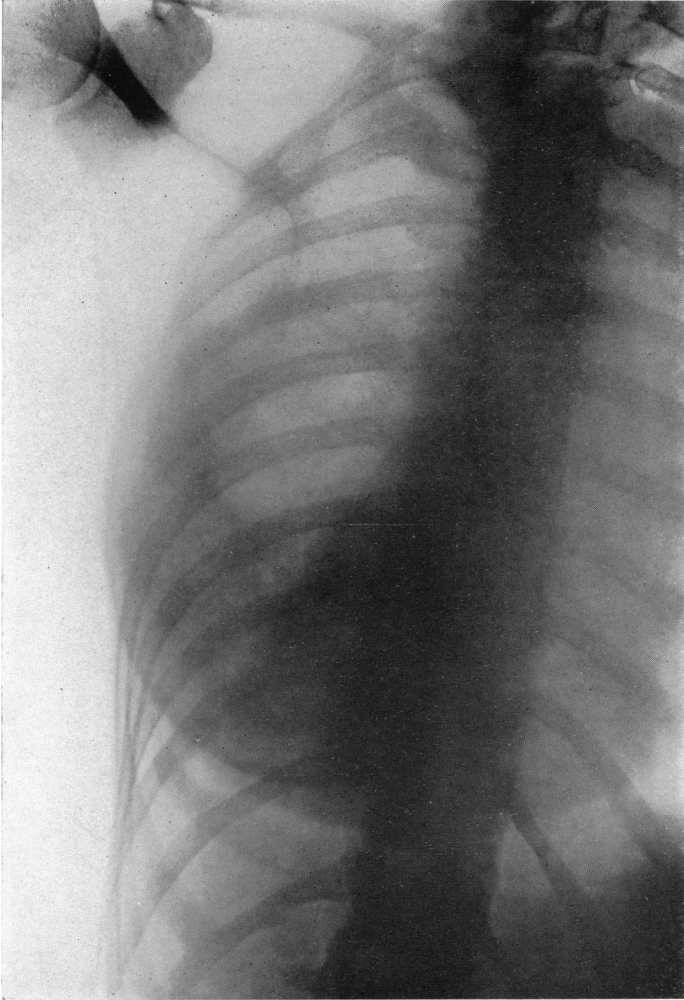
X-ray of patient before operation, showing tumor.

FIG. 2.



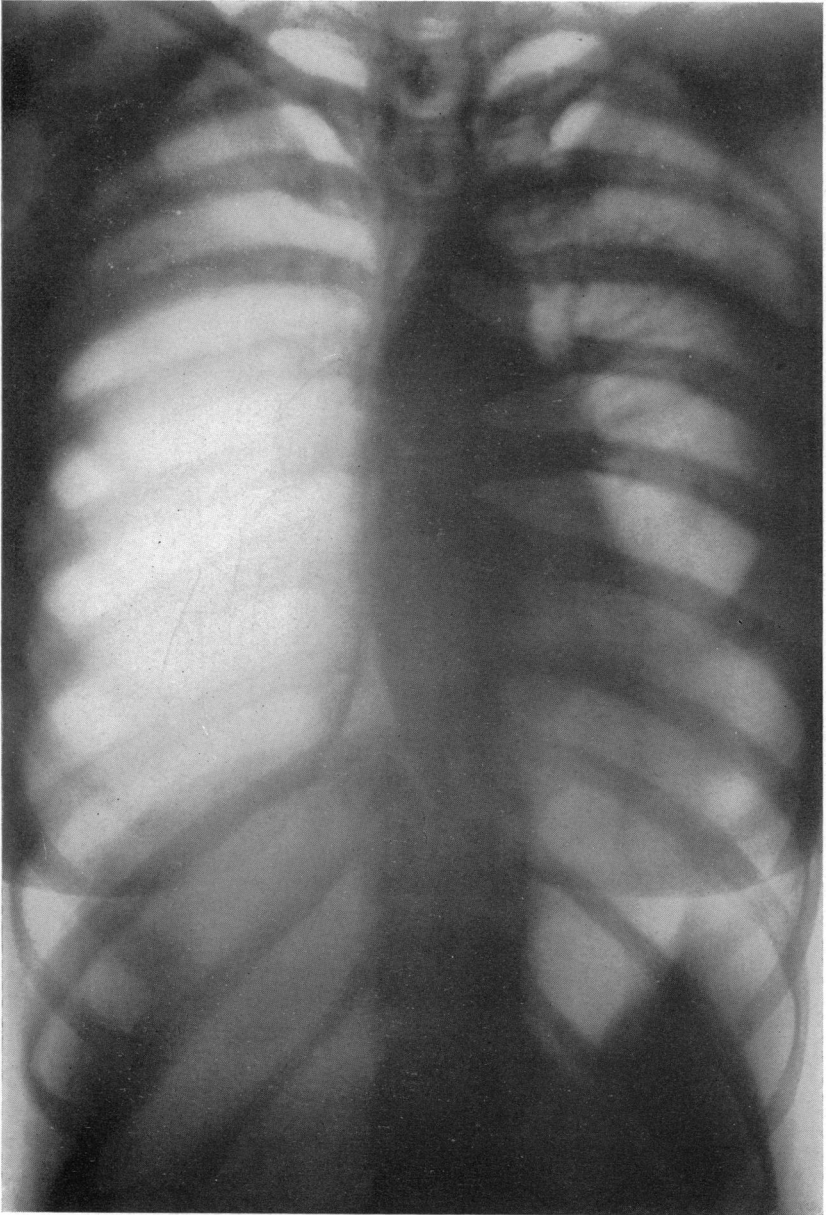
Photograph of patient after operation, showing incision.

FIG. 3.



X-ray of left chest taken October, 1912, four months after operation, showing absence of tumor.

FIG. 4.



X-ray taken April, 1913, showing thickening of the pleura and absence of tumor.

FIG. 5.

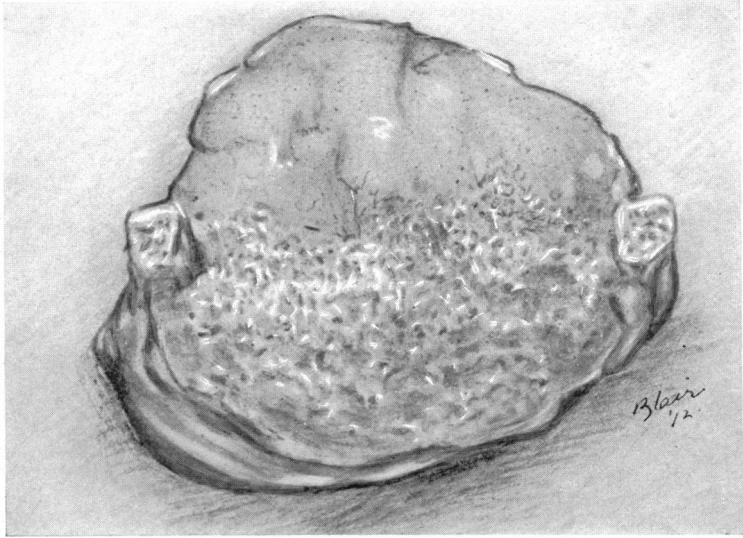
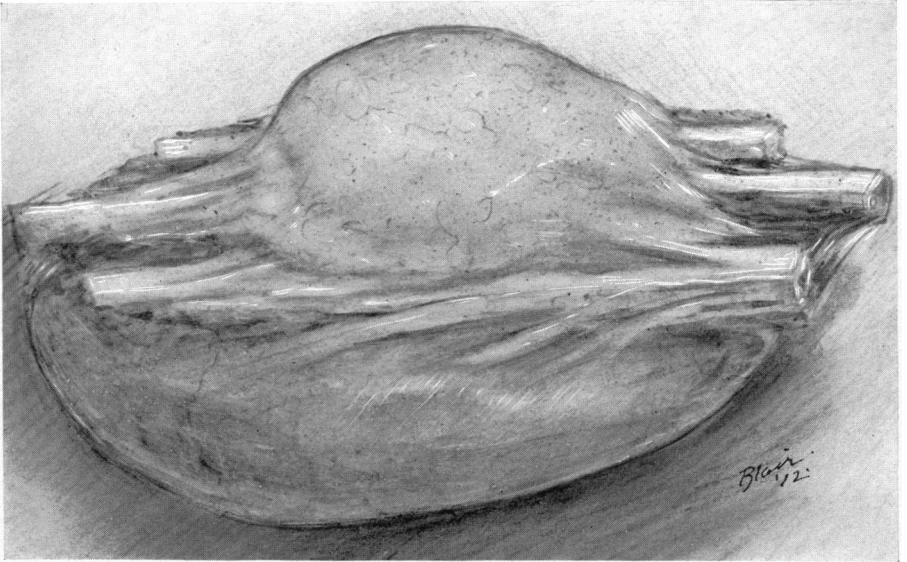


FIG. 6.



FIGS. 5 and 6.—Specimen of sarcoma of ribs.

done under intratracheal anæsthesia, and the lung was kept continually blown up with the bellows until its close. It being then necessary to sponge out some blood which had run into the pleura, the lung was allowed to collapse and the cleansing of the pleura was easily accomplished. There was a good deal of hemorrhage from the muscular tissue. The intercostal arteries were tied and all hemorrhage stopped as far as possible; then, the lung being blown up so as to fill the pleura entirely, the greater pectoral and latissimus dorsi muscles were sewn together across the opening with interrupted sutures of catgut. The skin was then sewn with a Bartlett suture of silkworm gut (Fig. 2).

The patient bore the operation well and was in good condition the next day. On the second day, her breathing became rapid and irregular, and she became somewhat cyanotic. I found some dulness over the lower part of the pleura, tapped the chest, and after removing about nine ounces of blood, the symptoms were relieved.

Two days later, the symptoms returned to a slight extent, and I again tapped the chest, and this time got four ounces. The patient ran a rather rapid pulse, 100 to 120, and a slight temperature for two weeks. This temperature was undoubtedly due to absorption of blood clot.

It is possible that the negative pressure caused by tight suture of the pleura may have at first tended to increase the hemorrhage but I do not believe that this was a serious factor. There was slight dulness over the lower part of the chest and bronchial respiration over the upper part, the upper back, the middle back, and the upper front. The temperature fell to normal at the end of two weeks, and the wound healed by first intention. She went home in three weeks and has since been well. I present an X-ray (Fig. 3) taken in October, 1912; and another one (Fig. 4) taken in April, 1913; showing a slight shadow on the left, probably due to thickening of the pleura, but the entire absence of any signs of tumor, the ends of the ribs showing clean edges where they were cut off (Figs. 5 and 6).

A brief review of the literature since Parham's paper in 1898 shows that twenty-eight cases have been reported.

Among the more interesting communications on tumors of the chest wall is an article by Rixford in the *Transactions of the American Surgical Association*, 1905, volume xxiii, in which he reports four cases of resection of the chest wall for recurrent carcinoma of the breast, and one of sarcoma of the clavicle involving the first rib and sternum. He used a wet towel tucked under the opening in the chest as soon as it was made to occlude it, thus closing the opening and checking the lateral excursions of the lung and mediastinal tissues. The towel was folded on itself two or three times, and slipped beneath the partially loosened section of the chest wall at the moment of complete expiration when the chest was largely emptied of air; and in all the cases there were no untoward symptoms from pneumothorax. No drainage of wounds or pleura.

REHN, *Archiv. für Klinische Chirurgie*, 1906, 81, p. 362, reports three cases of tumors of the chest wall, involving the removal of large portions thereof. He considers the operation dangerous. Campo, he says, has collected reports of 57 cases, of which 11 died as a direct result of the operation. Removal of chest wall tumors when the pleura is not opened is not a serious matter. Opening the pleura is in itself serious, and only one recovery is reported in literature where both pleuræ were opened: that of Franz König. Rehn advocates suture of the lung to the pleura with a large curved needle before opening the latter; and as soon as the pleura is opened, drawing the lung out with the hand by means of warm, moist compresses. At the close of the operation, he sutures the lung to the chest wall, and closes the skin without drainage.

DOLLINGER produced pneumothorax by making a cut into the pleura several days before the removal of a tumor of the chest wall, so that it may not be immediately produced at the time of the operation.

SAUERBRUCH reports two cases of resection of wall of thorax for carcinoma of mamma; one was adherent, one a recurrence after removal of a breast cancer. In the first case, the breast and infiltrated soft spots were removed with resection of two ribs. A flap of skin from the side was laid upon the lung with no distortion, and healed normally in place. The flap was the size of the palm.

In the second case, three ribs were removed, with soft parts, leaving an area thirty centimetres long by twenty-one centimetres wide, and pleura also to this whole extent. No pleural adhesions, and sound lung. The large area was covered by a flap from the side and transplantation of the opposite breast. Good recovery of patient and gain in weight.

C. B. LÖSKWOOD, in *The Clinical Journal*, September 25, 1907, reports

two cases of tumor of the chest wall, one a carcinoma following carcinoma of the breast. The patient with carcinoma of the chest wall, in which several pieces of several ribs had to be removed and the pleura opened widely, recovered and was well for a year. The second case was one of spindle-celled sarcoma of the chest in a girl of seventeen years. Portions of the fifth, sixth, seventh, and eighth costal cartilages were removed. The diaphragm was infiltrated and the peritoneal cavity opened, and the apex of the pericardium also removed. There was some shock at the time the pericardium was opened. A portion of the lower lobe of the left lung was removed. Hemorrhage from the lung was stopped by a cautery. After removal of the tumor and closing of the opening in the peritoneum and pericardium, the thoracic wound was closed without drainage. There was very severe shock. The patient rallied, recovered, and was well six months afterward.

W. O. ROBERTS, *Louisville Journal of Medicine and Surgery*, January, 1906, speaks of thoracic resection for tumor growing from the bony wall of the chest. Found a small tumor, and the rib from which it was growing was removed.

Other cases reported in the literature will be found in the following table. On looking these over, it will be seen that as far as the table goes, there is little difference in the above as to whether Sauerbruch's cabinet was used, or the pressure apparatus, or simply closing the pleura with compresses. It will be found, for instance, that there were 28 cases reported, of which 26 recovered and only 2 died,—a very small mortality; that in only 3 of the cases was either the Sauerbruch cabinet or positive pressure employed; closure of the opening by compresses or traction on the lung was employed in 11 cases; shock was present in 9 cases, absent in 13, and not mentioned in 6. Murphy's positive pressure apparatus was employed in one case.

These are all the cases that I have been able to collect since the publication of Parham's paper in 1898.

As far as one can tell, the sudden wide opening of the pleura tended to produce shock, and the opening of the diaphragm produced shock whether positive pressure apparatus was or was not used. I think there is no doubt, however, entirely irrespective of statistics, that in cases of equal severity those operated upon with positive or negative pressure would do better than the same cases operated upon with-

ABSTRACTS OF REPORTED OPERATIONS FOR SARCOMA OF CHEST WALL.

Name and Date.	Operation.	Method contra Pneumothorax.	Shock.	Result.
Webber (<i>Lancet</i> , 1900, ii, p. 1347).	Removal of sixth left rib with tumor. Left pleura and pericardium freely opened. Left lung collapsed.	Not mentioned.	Not mentioned.	Recovery in spite of bronchitis.
LeDentu (<i>Bull. et Mem. de Soc. de Chir. de Par.</i> , 1902, 28, p. 244).	Removal of parts of 3 ribs for chondrofibroma with small portion of diaphragm.	Traction on lung. Pleura opened freely and as late as possible. Drainage of pleura. Suture of lung to skin flap.	Marked on opening pleura.	Double pneumonia followed, which still existed at date of report, 2½ months after operation.
Griffith (<i>Lancet</i> , 1902, ii, p. 991).	Resection of sternum from 2d to 7th costal cartilages. Left pleural cavity opened. Growth (sarcoma) not completely removed.	None. Pleural opening could not quite be closed by sutures.	Slight.....	Recovery from operation. Death 4 mo. after.
Delorme and Piollet (<i>Lyon Med.</i> , 1902).	M.30. Tumor attached to 7th, 8th, and 9th ribs. Removed. Pleura widely opened. Lung retracted deeply. Small gauze drain in pleura.	No apparatus..	No shock.....	Recovery.
Israel (<i>Berl. klin. Woch.</i> , Mar., 1903, No. 22).	Removal of a tumor of the body of the 6th dorsal vertebra. Small opening of pleura was made.	Opening stopped up with gauze packing.	No shock.....	Recovery.
Reeve (<i>ANNALS OF SURGERY</i> , 1903, 37, p. 724).	Resection of 3 ribs on right for tumor. Opening in pleura size of 2 hands. Diaphragm injured but not opened.	Not stated....	No shock.....	Recovery.
Rixford (1905. <i>Transactions, Am. Surg. Assoc.</i> , vol. xxiii).	Four cases: 3 of carcinoma of chest wall secondary to breast carcinoma. One sarcoma of clavicle involving 1st rib and sternum.	Hot, wet towel tucked under edges of opening so as to close it as far as possible.	Not present on opening pleura.	All recovered.
Deruginsky (<i>Am. Surg.</i> , 1906).	1st: removal of parts of 8th and 9th left ribs. 2d: removal of all left thoracic wall from 7th to 11th ribs with a portion of diaphragm.	Gauze tampon. Gauze tampon.	Did not ensue upon opening pleura.	Recovery.
Torek (<i>Post Graduate</i> , N. Y., 1906, p. 335).	Removal of 4th, 5th, 6th, and 7th ribs for sarcoma, with portion of lung. Numerous metastases in pleura and lung.	None.....	Severe.....	Death from shock.
Rehn (<i>Archiv. klin. Chir.</i> , 1906, 81, p. 362).	1. Removal of portions of 3rd, 4th, 5th, and 6th ribs for recurrence after carcinoma of the breast. 2. Removal of 12 cm. of 4th and 5th ribs, (Right) for sarcoma.	Lung drawn out and sutured to chest wall. Lung drawn out and sutured to opening in chest wall.	None..... None.....	Recovery and long freedom from relapse. Recurrence. Death from secondary operation, 3 months later.

ABSTRACTS OF REPORTED OPERATIONS FOR SARCOMA OF CHEST WALL—Cont'd.

Name and Date.	Operation.	Method contra Pneumothorax.	Shock.	Result.
Rehn (<i>Archiv. klin. Chir.</i> , 1906, 81. p. 362).	3. Removal of a sarcoma of the size of the fist with the 2d and 3d ribs on the right.	Lung drawn out and sutured to opening in chest.	None.....	Recovery. No recurrence in a year.
Roberts, W. O. (<i>Louisville Jour. of Med. and Surg.</i> Jan. 1906).	Removal of a tumor of the chest wall with attached rib.			
Lockwood, C.B. (<i>Am. Jour.</i> , Sept., 1907).	1. Carcinoma recurrent after breast carcinoma. 2. Spindle-celled sarcoma in girl of 17. Two portions of 5th, 6th, 7th, and 8th cartilages were removed. Diaphragm was opened, and apex of pericardium removed. Some shock when pericardium was opened. Portion of lower lobe of left lung removed. Hemorrhage from lung stopped by cautery.	Nothing done to prevent pneumothorax. Nothing done to prevent pneumothorax.	Very severe...	Recovered and was well 6 months afterwards.
Hoffman (<i>Beit-räge, z. klin. Chir.</i> , 1908, p. 182). Operation by Kuttner.	Removal of sarcoma of 5th, 6th, 7th, and 8th ribs, with spontaneous fracture of the 5th rib, from an 18 year old girl.	Sauerbruch cabinet.	None.....	Recovery.
Mollimard (<i>Faculté de Med. et Phar. de Lyon</i> , Tome 9, 1908). Operator, Poncet.	M. 18. Sarcoma of 7th, 8th, and 9th ribs. Diaphragm injured and closed by suture.	No apparatus..	Not stated....	Recovery.
Porter (<i>Boston Med. and Surg. Jour.</i> , Dec. 24, 1908).	Enchondroma of 6th, 7th, 8th, and 9th ribs; removed with injury to and suture of diaphragm. Lung sutured to intercostal muscles at close to prevent retraction.	Dr. F. T. Murphy's positive pressure box.	None on opening pleura.	Death, pneumonia, 14th day.
Hoffman (<i>Beit-räge z. klin. Chir.</i> , 1908, p. 182). Operation by Kuttner.	Resection of two ribs for recurrent carcinoma.	Sauerbruch cabinet.	None.....	Recovery.
Menistrina, J. F. (<i>Med. Forinighilly</i> , St. Louis, 1909).	M. 55. 6th, 7th, 8th, and 9th ribs removed for sarcoma.	Pleural cavity opened slowly and packed off with gauze.	Slight.....	Recovery.
Huguer and Rigollet-Simonnot, Paris, 2, 1910.	M. 52. Chondroma of chest wall, involving 7th, and 8th ribs which were removed with it. Resection of a portion of the diaphragm.	Pleura opened slowly. Lung sutured to ribs.	None.....	Recovery. Chest had to be tapped twice to remove blood.
Pier (<i>Deutsche med. Woch.</i> , 1911, No. 24).	M. 15. Removal of carcinoma involving 3 ribs, and resection of a portion of diaphragm.	Brauer's positive pressure cabinet.	Severe, but checked when opening in diaphragm was sutured.	Recovery.

out special apparatus; and also that the same cases operated upon under intratracheal anæsthesia would do still better than in the cabinets, and at vastly less expense and trouble. I feel, indeed, that we can hardly better express the contributions of the intratracheal addition to thoracic surgery than in the words of Gosset: "La peur du pneumothorax ira retrouver la crainte du peritoine."

I wish to acknowledge my indebtedness to Dr. Samuel Robinson for his kindness in letting me see his cases in consultation and for furnishing me with references to literature.

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