THE ADVISABILITY OF TOTALLY EXCISING BOTH PECTORAL MUSCLES IN THE RADICAL OPERATION FOR CANCER OF THE BREAST*

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Judging from the recent literature with reference to the two methods of radical operation for cancer of the breast, as originally proposed in 1894 (Annals of Surgery, 1894, xx, p. 495, and *New York Medical Record,* December 15, 1894), it would seem that the majority of surgeons have accepted the excision of the deep tissues from the axilla toward the chest, forming the pedicle of the mass alongside the border of the sternum. Many of them are also making use of Handley's addition to the radical operation, which consists in extirpating the anterior sheath of the recti muscles in the triangle bounded by the ensiform process and upper portion of the two costal arches, and necessitates placing the lower (inner) angle of the skin incision in the median line, about midway between umbilicus and lower end of the sternum, instead of over the sternum close to the inner border of the opposite mammary gland. Handley's addition has the technical advantage of giving great mobility to the two skin flaps, which, when reflected widely, expose the seat of the disease, so that their borders usually can be approximated by sutures throughout, rendering skin grafting unnecessary.

However, there is one important point in the technic of the radical operation, regarding which there still seems to exist considerable difference of opinion, and that is the question of excising the pectoral muscles in their entirety.

To contribute to the discussion of this question is the object of this paper.

Anatomy.—The pectoralis major muscle is an adductor of the arm, the minor pulls down the shoulder or, when the shoulder is at rest, raises the ribs. The major takes its origin in two divisions, from the sternal extremity of the clavicle—"clavicular portion"—and from the anterior surface of the sternum and the cartilages of the six upper ribs, often also the aponeurosis of the external oblique abdominal muscle—sternocostal—or, briefly, "sternal portion." The two portions after being enjoined into one broad strong tendon, two inches wide, insert on the spine of the major tubercle of the humerus, about an equal distance away from the anatomical neck of its head. The pectoralis minor takes its origin from the external surface of the second to fifth rib and inserts on the coracoid process of the scapula.

It is probable, that after extirpation of the two muscles, the combined

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work of the serratus anticus major, teres major and the two rhomboids assume their function. Still it is natural that the gross power of adducting the arm will be permanently decreased except continuous gymnastic exercise of the substituting muscles makes up for the defect.

The *blood supply* of the clavicular portion of the major and the belly of the minor is derived principally from the rami thoracici of the thoraco-acromial artery, the first branch of the axillary artery. Sometimes the first of the rami thoracici leaves the axillary artery direct; it is then called arteria thoracica suprema. The sternal portion of the muscle receives its blood mostly from the rami perforantes of the internal mammary artery. The serratus anticus major muscle and the external portion of the mammary gland are fed by the long thoracic artery.

The veins return the blood as usual to the namesakes of the respective arteries.

The *nerves* of both pectoral muscles are represented by the anterior thoracic nerves, branches of the supraclavicular portion of the brachial plexus. It has been stated that the nerve supply of the pectoralis major muscle is arranged in such a manner as to produce paralysis of the clavicular portion when its sternal position is extirpated with the breast.

The *lymph-vessels* of the breast itself—there usually exists an internal and an external collecting lymphatic trunk—discharge into one or two glands placed on the inner wall of the axilla on the third digitation of the serratus magnus. These glands constitute the supero-internal group of the thoracic chain of axillary glands.

The lymphatics of the two pectoral muscles run towards the subclavian glands or to the thoracic group of the axillary glands. A further portion of the lymph of the pectoral muscles takes its way through the trunks which escort the perforantes plexuses and discharge into the glands of the internal mammary chain that cluster around the inner surface of the junction of the second to seventh rib cartilage and the sternum. Behind the manubrium sterni the latter form a mammary truncus, right and left, which empties into the thoracic ducts. The lymph-vessels of the anterior mediastinum, on either side of the sternum, communicate across the posterior surface of the latter.

Clinical observation and autopsies have shown that this part of the lymph current usually becomes charged with cancer cells only at a late stage of the disease.

Besides the two collecting trunks of the breast itself, mentioned before, accessory channels are not infrequently met with. There are three of this type, the axillary, subclavian and internal mammary; of these the subclavian is the most important one with regard to the subject under discussion. In its course now and then lymphatic glands are met with, the so-called inter-pectoral and retropectoral glands. I have repeatedly met these glands in the course of my work, first in two cases operated upon in the early nineties, when it was customary to remove the pectoral muscles *after* ablation of the

breast, as the second stage of the operation. This finding was one of the principal reasons next to the saving of blood that induced me to leave the space *between* the two muscles undisturbed, and extirpate both muscles together and entirely in one mass (see technic of the operation, published in 1894). The occasional presence of these glands and the correctness of the operative procedure, worked out on basis of this clinical observation, was later corroborated by Grossmann and Rotter, by experimental and microscopic research. Grossmann succeeded in three out of thirty subjects, when injecting from the mammary gland the lymph-bearing vessels which perforate the great pectoral, in thus making clearly visible a lymphatic trunk, which detached itself from the posterior surface of the mamma, then perforated the pectoralis major and *running between this muscle and the pectoralis minor* reached the subclavian glands. This trunk was a satellite of the superior thoracic artery or of the thoracica suprema (see above), which latter enters into the space between the pectoralis major and minor, and showed in its course two or three small glandular nodules. According to Rotter, who, on careful dissection of specimens of cancer of the breast, found this accessory subclavian channel of Grossmann, these inter- or retropectoral glands exist in nearly one-half the cases of breast carcinoma and cannot be recognized with the pectoral muscles *in situ*.

Rodman observed retropectoral enlarged lymph-nodes in two cases.

Regarding the lymph current in the two portions of the pectoralis major muscle, it is to be assumed that in some individuals there exist communicating branches. Division of the great pectoral muscle in the groove between the two portions necessarily divides, *i.e.*, opens, such lymph-vessels, which may be filled with cancer cells. The skin and subcutaneous tissue of the two upper quadrants of the breast often discharge their lymph directly into the supraclavicular group of glands, the lymph-vessels passing in front of the clavicle.

Further details of this important chapter of lymph-vessel arrangement and distribution can be found on pages 208 to 227 in " The Lymphatics " by Delamere, Poirier and Cunéo, translated by Leaf.

One of the generally accepted laws in operations for carcinoma is to keep in reverential distance from the seat of the disease—not to enter the infected area if it can possibly be avoided; in other words, work within healthy tissue as far as possible, and try to lift out the tumor " en masse " with lymph-vessels and lymph-glands. The more completely and in accordance with anatomical relations this is accomplished, the better the chances for a successful and permanent issue of the radical operation.

Nowhere in the body are conditions more favorable for obtaining such a result than with cancer of the breast, provided the case is not too far advanced.

The upper and lower skin flaps properly reflected to the anatomical landmarks expose the seat of the malignant invasion. I have come to consider the removal of the skin of the entire breast a necessity, and have

abandoned the division of the superior flap at right angles to the direction of the breast incision toward the middle of the clavicle, as first proposed by me in 1894 (*Med. Rec., loc. cit.*). Some surgeons, among them Parker Syms, of New York City, who has done so much for a better understanding of this radical operation, still adhere to this part of the original technic. I lay great stress upon keeping the knife above the pectoral fascia and forming the flaps with as little fat tissue adherent as possible, just enough to eliminate all the fear of subsequent gangrene. At the very base of the two flaps the exposed fascias are incised parallel with the base line of the skin flaps. The fascia covering the latissimus dorsi is usually left alone, as not pertaining to the infected area, except the growth has developed in the extension of the glandular breast tissue close to the axilla or in an aberrant portion of the mamma in this region. In such cases, as Handley particularly points out, the deep fascia has to be excised in the deltoid region as well as far backward over the surface of the latissimus dorsi. The border of the latter muscle forms the posterior landmark for reflection of the lower flap in the uncomplicated case.

As regards the excision of the deeper tissues, it seems best to commence with Handley's addition to the radical operation, namely, the removal of the upper portion of the anterior sheath of the two recti. This is often a somewhat bloody as well as cumbersome procedure on account of the firm interwovenness of the sheaths with the linea alba. However, with a little patience these sheaths can be lifted in one piece, in conjunction with some of the bundles and the fascia covering the serratus anticus major. The greater part of the latter's fascia is also removed and carefully dissected upward, with such digitations of the muscle as lie in direct contact with the deep surface of the breast, until the lowest bundles of the pectoral muscles are reached. It seems wise to include in this extirpation also a superficial layer of the digitations of the external oblique which arise from the fifth and sixth ribs (Handley). During this work properitoneal fat is often exposed in the median line. This, however, does not need to make us fear the later occurrence of a ventral hernia, even if the recti muscles are not or cannot be stitched together in the median line; at least I have never seen it.

If, now, the lower border of the cephalic vein has been clearly exposed and followed up toward the clavicle, and thus the deltoid has been separated from the upper outer border of the major pectoral within the groove dividing these two muscles, and if further, the tendon of the pectoralis major muscle has been approached from below by following the lower border of the muscle in the axilla upward toward the humerus, the next step is to push the closed blades of a large Cooper's scissors, followed by the surgeon's gloved left forefinger, through the very beginning of the first bundles of the pectoralis major muscle, next to its tendon. The primary total division of this tendon, then following, makes the extirpation of the entire major pectoral muscle a matter of forced anatomical sequence. Taking the course

of the lower border of the exposed cephalic vein as a guide, the knife quickly reaches the clavicle. By now taking a gauze wipe and pressing it with the left hand on to the muscle fibres in a downward direction, thus putting the individual muscle fibres on the stretch, it is a very easy matter for the operator to cut through the pectoralis major muscle alongside the lower border of the clavicle up to a point somewhat beyond the sternocleido junction, without dividing the vessel plexuses below. The latter invariably come clearly into view, are caught by two clamps and divided in between. Annoying hemorrhage is hardly ever encountered, and can, with some care, always be avoided. With the tendon of the pectoralis minor sharply or bluntly approached, and then also surrounded with the surgeon's left forefinger and divided at the coracoid process, the inferior clavicular region is wonderfully well exposed. One horizontal sweep of the knife through the deep fascia from the axilla to the clavicle lays open the axillary and subclavian vessels and enables us to bloodlessly remove the axillary fat plus glands in one mass, the whole always remaining attached to the bulk of the area to be removed, a procedure familiar to every surgeon who once has done this excision from the axilla toward the sternum. Having clearly exposed and freed the lower border of the subclavian vein up to the spot where it dips beneath the clavicle, the superior clean excision is finished. The operation, so far, has been attended with an extremely small loss of blood. The lymph-vessels of the breast as such have remained in "*closed*" communication with the corresponding lymphatic glands in the axilla and subclavicular region. The last gland lifted out very near the angle between subclavian vein and chest wall is to be handed to the pathologist for immediate frozen section examination. If it shows carcinoma, the supraclavicular space is cleaned out at the same sitting. This additional operation if required is best done as the last step in the course of the radical operation. Thus the pathologist will have time for a study of the frozen sections, while the surgeon completes the excision of the cancerous breast. All that then remains to be done is the formation and division of the pedicle of the mass. In this step, particularly, the principle of keeping out of the infected area can be beautifully carried out in the type of radical operation that works from the shoulder toward the sternum.

If the case in hand is an advanced one, the subscapular space is also cleaned out, if possible with the preservation of the subscapular nerves. If, on the other hand, the case seems to be an early one, this part of the operation may be omitted. The bladè of the knife is then turned toward the chest obliquely within the hollow of the funnel formed by the chest wall and the reflected lower skin-flap and, without entering the subscapular fat; the superior portion of the fascia of the serratus anticus major muscle is prepared upward toward the outer border of the pectoralis minor muscle. This fascia was incised before, parallel with the base of the lower skin flap, at the time when the fascias in the epigastric regions were removed. As soon as the bundles of the pectoralis minor are reached, the first assistant takes hold of the mass, not with sharp retractors, but with his hands, and lifts it up

without exerting any pull whatever. He is merely to support it, as otherwise he is bound to strip periosteum off some rib, or, as more frequently happens, perichondrium from one or more rib cartilages, which may result in cartilage necrosis and delay wound healing.

Keeping with the knife as closely as possible to the chest-wall, the operator will be able to see the perforantes arteries and clamp them before they are divided. If cut before clamping, the spurting vessels are also easily caught. However, blood thus lost might well be saved. Finally, the muscular pedicle, extending in a vertical direction, is amputated with knife or scissors parallel with the border of the sternum.

The decision as to whether the subscapular space should be cleaned out, *i.e.,* whether the connective tissue, fat and fascia covering the subscapular muscle should be excised, must be left to the individual surgeon. It must also be left to his discretion to decide whether or not the supraclavicular space should be cleaned of its contents.

In stripping the fat and connective tissue off the intercostal muscles and ribs at and inward from the place where the subclavian vein disappears beneath the clavicle, the lymphatic vessels communicating with the nodes above the collar bone, of course, have been opened, a fact which may represent a disadvantage to the patient. Unfortunately, this cannot be avoided, except we make it a rule to divide the clavicle in every case and then try to remove the package of lymphatic nodes and vessels below and above in one continuous mass.

From the purely radical point of view, such a demand could be justly established. However, we know from experience that carcinomatous involvement of the supraclavicular glands means death of the patient in more than 95 per cent. of the cases. On the other hand, we know that many patients have remained perfectly well after the radical operation, for ten to twenty years and longer, in fact, have to be considered completely cured; yet the supraclavicular glands were not removed. The point simply is that the glands are not often invaded by the disease. Therefore, to add typical cleaning-out of the lymphatic system on both sides of the clavicle, as a *routine measure* in the radical operation for cancer of the breast, does not appear to be called for, and therefore should not be done. But it should be done if there is the shadow of a doubt that the disease has reached the neck. The result of the microscopical examination of the innermost infraclavicular gland during the operation, as mentioned above, will have to be the guide, also the fact whether a tumor in one of the two upper quadrants of the breast has become adherent to the skin (see above). Early extirpation of the supraclavicular glands at a time when they are not yet adherent to muscles, veins and thoracic duct, will certainly greatly improve the prognosis of the given case. Additional division of the clavicle must be left to the judgment of the individual operator.

Proceeding in the manner just described, the seat of the disease is not entered at any step of the operation, as far as this is at all possible from an

operative point of view. The knife works altogether outside of the infected area. Both pectoral muscles are completely excised from their insertion to their origin; *the lymphatic system in and between them is left undisturbed.*[1] The operation is radical, anatomical and typical. It is feasible within a short space of time and can be carried out with comparatively little loss of blood.

The question naturally arises: Why is this complete excision of both muscles still a mooted point in the technic of the radical operation for cancer of the breast? Why was this method of continuously working with the knife *outside* of the seat of the carcinoma, this possibility of lifting out the entire invaded field in its normal, undisturbed anatomical relation, not generally accepted from the start, after its proposal in 1894?

The reasons seem to have been twofold:

1. Because Halsted, by a peculiar coincidence, published his method of radical breast operation from the sternum toward the shoulder with preservation of the clavicular portion of the great pectoral muscle and the division, dissection and resuturing of the pectoralis minor muscle, simultaneously with the procedure described above, and naturally, the weight of his authority turned the scales toward his method of procedure.

2. Because the total extirpation of both pectorals was considered mutilating and unnecessarily radical by many surgeons.

To-day, after the plan of the radical breast operation devised and published in New York, twenty-four years ago, has been so generally accepted, it seems hardly necessary to discuss the objections under No. 2. That the operation *is neither mutilating* nor unnecessarily radical is now generally conceded.

The preservation of the clavicular portion of the major pectoral muscle makes extremely little difference in the cosmetic result. Besides, the operating field is later on always covered by the patient's dress. The functional result of the arm, on the other hand, is absolutely perfect. The "statue of Liberty" posture, as I ventured to call the result in 1904, can be obtained in every instance. If it is not obtained, this is not the operator's fault, but due to the negligence of the patient in failing to carry out the surgeon's directions for proper exercises. Lastly, it has been stated, as mentioned above, that the arrangement of the nerve supply of the pectoralis major muscle involves paralysis of the retained clavicular portion after the excision of the sternal portion. I cannot speak from personal experience in this matter, as I have never left the clavicular portion of the muscle behind.

Rodman, fearing that stiffness of the arm would result if the muscles were completely excised, left their tendon and the nearest portion of the major pectoral muscle adjacent to it *in situ* and cut through this part of the muscle's belly at right angles to its fibres. In view of what has been said above, it is difficult to see either the advisability or the necessity for such a variation of the operation. All my patients have been satisfied with the functional result of the operation, while, of course, the *gross* power of the

[1] See above under anatomy of the lymphatic distribution.

arm is reduced in proportion to the muscular mass removed; usually the bellies of the substituting muscles, if sufficiently exercised, acquire considerable compensating strength.

It still remains to be proven that the operation is not too radical. To-day it is a generally accepted principle to extirpate completely a muscle involved in malignant disease, *i.e.*, from tendon to its origin. Heidenhain emphasized this necessity as early as 1889 in his classical essay "On the Causes of Local Recurrence of Cancer after Amputation of the Breast." [2]

For this reason I also consider it inadvisable to preserve portions of the muscle for the purpose of covering the brachial nerve plexus and the large blood-vessels, in order to try and avoid by such procedure the later appearance of neuralgia and œdema of the arm. I have rarely seen persistent neuralgia subsequent to the radical operation. Should chronic œdema set in later, it can be overcome by dividing the deep fascia in a number of places. (W. E. Sistrunk: Elephantiasis Treated by Kondoleon Operation. From the Mayo Clinic, Surgery, Gynecology and Obstetrics, vol. xxvi, April, 1918, p. 388.)

The possibility that communicating lymph-vessels exist between the two portions of the pectoralis major muscle, and the anatomical fact that infected lymph-nodes with afferent and efferent lymph-vessels are encountered now and then between and beneath the two pectoral muscles, ought to be sufficient proof, it seems to me, to convince the thinking surgeon that he cannot be *too* radical in dealing with this treacherous disease.

A recent experience brought this home to me most strongly: On examining the specimen obtained at one of my latest radical operations for a scirrhus in the upper quadrant of the breast, I found that a small tumor which before operation had appeared well movable with the breast in all directions had grown in cylindrical fashion perpendicularly through both pectoral muscles. The circumference of the cylinder was not larger than a 50-cent piece. It had grown like a wedge in a sagittal line. When dividing the bundles of the minor pectoral muscle below the breast and parallel with the surface of the chest in the final stage of the operation, I left a very short stump of the pectoralis minor muscle attached to the chest for more convenient preparation of the field for grafting, should a skin defect ensue in spite of Handley's addition.[3] In view of the findings revealed on closer examination of the specimen after the completion of the operation, I regret having left this stump. What I should have done is to amputate the pectoralis minor fibres at once with the mass as close to the ribs as possible;

[2] Von Langenbeck's Archiv, 1889, vol xxxix, p. 97.

[3] A short stump of the pectoralis minor muscle, about one-sixth to one-quarter inch in length, can be safely left behind without fear of courting a local recurrence of the tumor. It is a well-known fact that *within the belly* of the pectoralis minor muscle cancer cells are never encountered, except in far advanced cases. What has been found with reference to this muscle are retropectoral lymph-nodes. And these, of course, are not met with at the place of origin of the muscle over the surface of the ribs, but rather up on the chest, underneath its belly.

or still better, I should have resected the underlying portion of the two ribs with their periosteum and intercostal tissues. This experience, which I have never had before, certainly has taught me to palpate for the lower portion of the tumor *during the operation,* before finally dividing the muscle, while working beneath the breast in finishing the radical operation. As matters stood in this case, only a thin layer of uninvaded muscle fibres separated the infiltrating tumor from the chest wall. The prognosis consequently is more dubious than otherwise, in spite of the subsequent prolonged X-ray cross-firing.

That the final results of our operations for cancer of the breast have been most happily changed since the advent of more radical methods, every surgeon knows and recognizes to-day. Most strikingly was this change for the better demonstrated to me when, in 1904 and 1907, ten and thirteen years after I first carried out the radical operation, I made my first statistical collection as regards end results (*Jour. Am. Med. Ass'n,* July, 1905, and *Surg., Gyn. and Obstetrics,* July, 1907). Whereas at the end of the first decade of surgical work from 1884 to 1894 I could not find a single one of my patients subjected to breast amputation, still alive, I then could state that three (Nos. 1, 2 and 6) of the very first patients in whom I had done the radical operation in 1894, 1895 and 1896 were in perfect health.

No. 4 of the series, who was operated upon in November, 1895, had died in July, 1902, of endocarditis, without symptoms of a recurrence of the cancer (coroner's case).

Nos. 1 and 2 of that series are alive to-day (1918) and cured of their cancer, as proven by recent personal examination. No. 6, operated upon in 1896, lived sixteen years after the operation and then succumbed to senile marasmus.

Of course, personal statistics do not prove much for or against a type of operation, as far as a cure of the malignant growth or prolongation of life is concerned, if the surgeon does not select his cases, but operates as they come along, refusing operation only if the disease has too far advanced. After all, it is the so-called virulence of the agent that produces cancer which determines the final result of our surgical work. That this agent will yet be proven to be a parasite, similar to the spirochæta pallida in syphilis, or a microbe, is my personal belief.

But it stands to reason that by keeping entirely outside of the seat of the disease,—a procedure that certainly appears possible in cases of cancer of the breast that come to operation at an earlier stage of the trouble,—we shall have done our share in preventing not only local or regional recurrence, but perhaps also metastasis.

Of course, some surgeons may say: " I have never removed the clavicular portion of the great pectoral muscle and have always left the minor behind, and yet from 30 to 40 per cent. of my patients have lived three, five and more years after the operation without recurrence." However, the point

in question is not: because Case X and Y got well after the radical operation without complete excision of the two muscles, therefore such excision is unnecessary. The question rather is: How many of the patients may have developed regional recurrence and metastasis because the space between the two portions of the pectoralis major muscle and particularly that between the pectoralis major and minor was entered with hands and instruments during the operation, and portions of the muscle were left behind?

The total extirpation of both pectoral muscles in their undisturbed and uninvaded anatomical connection and relation to the breast, as above described at length and also originally set forth in the author's previous articles on the subject (*loc. cit.*), offers an additional safeguard not only against local and regional recurrence, but in all probability also against metastasis.

The total extirpation of both pectoral muscles *in every case* of radical operation for cancer of the breast, certainly is logical and, as a surgical procedure, clearly indicated, particularly in view of the possible lymphatic arrangement. The author therefore holds that it should be generally adopted.