The Anatomy of the Pectoral Nerves and its Significance to the General and Plastic Surgeon

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It has previously been shown that in 62% of patients the medial pectoral nerve courses through the pectoralis minor muscle to innervate the lower half or two thirds of the pectoralis major muscle. In the other 38% of patients, the medial pectoral nerve exits around the lateral aspect of the pectoralis minor muscle. The lateral pectoral nerve courses on the undersurface of the pectoralis major muscle, innervating the proximal one third or more of the muscle. Consequently, when the pectoralis minor muscle is removed in a modified radical mastectomy, or dissection between the two muscles is performed, there is partial deinnervation of the pectoralis major muscle with partial atrophy and a decrease in size. Further, if the lateral pectoral nerve also is injured or removed, it can result in total deinnervation of the pectoralis major muscle with more severe atrophy and fibrosis of the muscle. In cosmetic augmentations, when the breast implant is placed behind the pectoralis major muscle, that muscle is partially deinnervated. In this clinical situation, this is believed to be advantageous because it allows the breast to project better. This paper details the anatomy of the pectoral nerves and discusses the clinical implications of surgery in this region as it relates to the size and function of the pectoral muscles.

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A LARGE NUMBER OF ARTICLES and books have been published in the last 10 years outlining in detail the surgical anatomy of various muscles[1–4] and their blood supply. This has largely come about by the rediscovery and interest in the transfer of tissue, *i.e.*, skin and muscle (and sometimes bone) called musculocutaneous or muscle flaps. Although nerve supply has been mentioned, the main focus of this work has been to identify vascular territories. This paper's purpose is to describe and emphasize the anatomy of the nerve supply, specifically to the pectoralis major muscle (PMM) and the pectoralis minor muscle.

There are two clinical situations in which we have found that a knowledge of the anatomy of the pectoral nerves, the pectoralis minor muscle, and the PMM are of particular importance.

The first clinical situation relates to the patient who has had a modified radical mastectomy (MRM) and has elected to have breast reconstruction. The MRM has various modifications, but the removal of the breast with an axillary dissection, beneath the PMM, usually superficial to the pectoralis minor muscle, appears to be a fair description of the procedure. Some surgeons advocate removal of the pectoralis minor muscle.

Our experience with breast reconstruction in patients who had undergone the Halsted radical was that the major objection (other than loss of the entire breast) was the depression beneath the clavicle. With the advent of sparing the PMM, this logically became less of a problem.

When MRM was first advocated in preference to the Halsted radical, we noted that in a significant number of the patients there were varying degrees of atrophy of the PMM. Further, a few patients who had undergone MRM were noted to have significant atrophy of the PMM and subclavicular depression.

Initially it was our belief that patients with PMM atrophy might present more difficulty in reconstruction, but in minor cases of atrophy, this was not a problem, particularly using the newer skin-muscle flap techniques.

The other clinical situation of note is the cosmetic surgery patient who desires breast augmentation. For the past 8 years we have placed the implant between the PMM and the pectoralis minor muscle with the hope that this would decrease the problem of scar tissue contracture that occurs in approximately 50% of the patients who have submammary augmentation. It can be reported that the incidence of capsular contracture with hardness has been significantly reduced by this one maneuver. Some plastic

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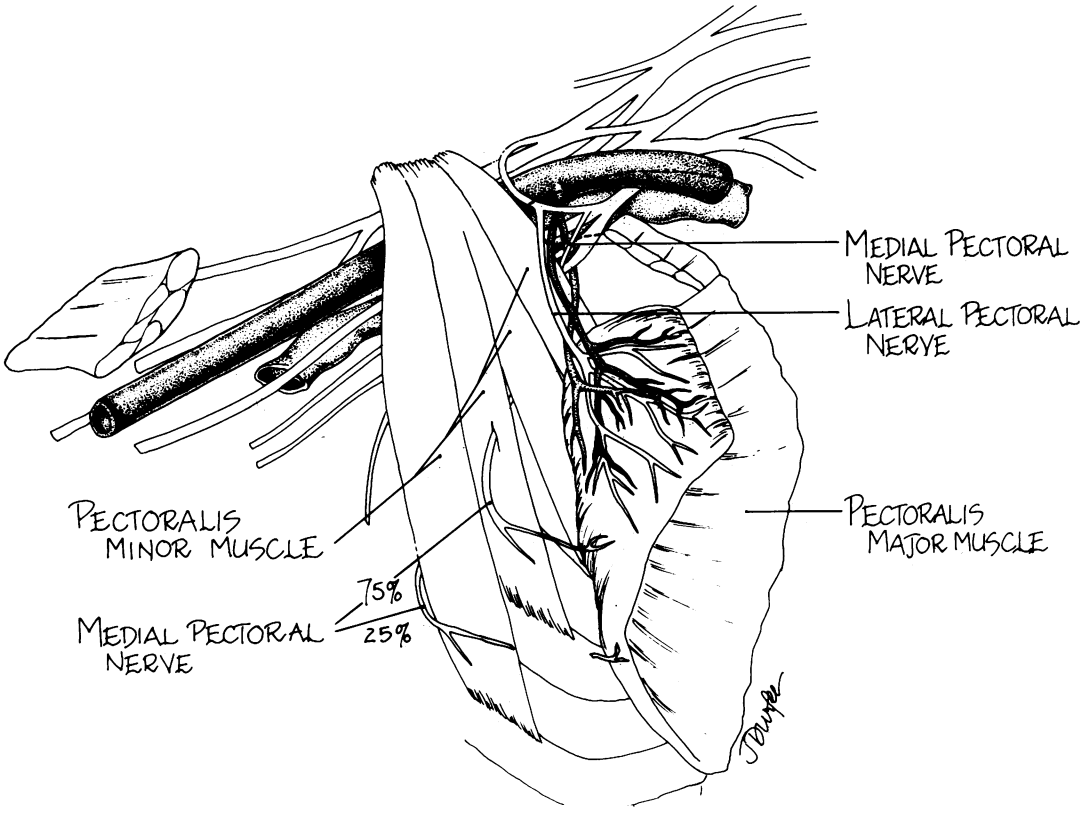

FIG. 1. Note the location and distribution of the lateral pectoral nerve(s) and the medial pectoral nerve(s). Branches of the thoracoacromial vessels are shown accompanying the lateral pectoral nerve.

surgeons who remain advocates of the submammary anatomic positioning believe that the submammary positioning of the implant gives better projection and a more attractive contour. Since we were well satisfied with the contour and projection of the subpectoral patients, we studied these patients to determine if there was an explanation. We observed that patients who have subpectoral implants projected better as months went by.

Methods

We reviewed the anatomy of the pectoral nerves, first in Gray's *Anatomy of the Human Body,*[5] Pernkopf's *Atlas of Human Anatomy,*[6] and other texts[1,2] plus published papers.[3,4] We agreed with previous published data[7] that the explanation of atrophy of the PMM after MRM and, in addition, improved projection in patients undergoing subpectoral augmentation (SPA) was due to partial deinnervation of the PMM.

Gray[5] indicated that the medial pectoral nerve, so named for its origin from the medial cord of the brachial plexus and its relation to the axillary artery, travels inferiorly beneath the pectoralis minor muscle. Its distal (Fig. 1) branches pass through the pectoralis minor muscle to innervate the lower portion of the PMM. It was further noted that the lateral pectoral nerve (Figs. 1 and 2), which arises from the lateral cord, left its position in relationship to the axillary artery and, accompanied by the pectoral branches of the thoracoacromial arteries and veins, coursed on the undersurface of the proximal portion of the PMM, thus innervating the proximal half and possibly the entire muscle.

In studying patients presenting for breast reconstruction after MRM, the findings were variable regarding atrophy. It is known that many muscles (including the PMM) are innervated by more than one nerve. Consequently, one nerve of a dual-nerve innervated muscle could be transected and the muscle could either show no significant clinical atrophy or demonstrate atrophy with decrease in bulk and strength. However, if both nerves are transected in a dual-nerve innervated muscle, the result would be severe atrophy of the muscle. Further, neuropraxia could occur with a temporary partial or complete deinnervation.

Results

In 75% of 100 consecutive patients who had SPA, motor nerve branches were noted *in vivo* to enter the undersurface of the PMM coming from the pectoralis minor muscle. The lateral pectoral nerve with vessels was noted on the undersurface of the PMM in all patients. Further, the lateral pectoral nerve was larger than the medial pectoral nerve(s), indicating a greater importance as to innervation.

Neuropraxia of single-nerve or double-nerve transec-

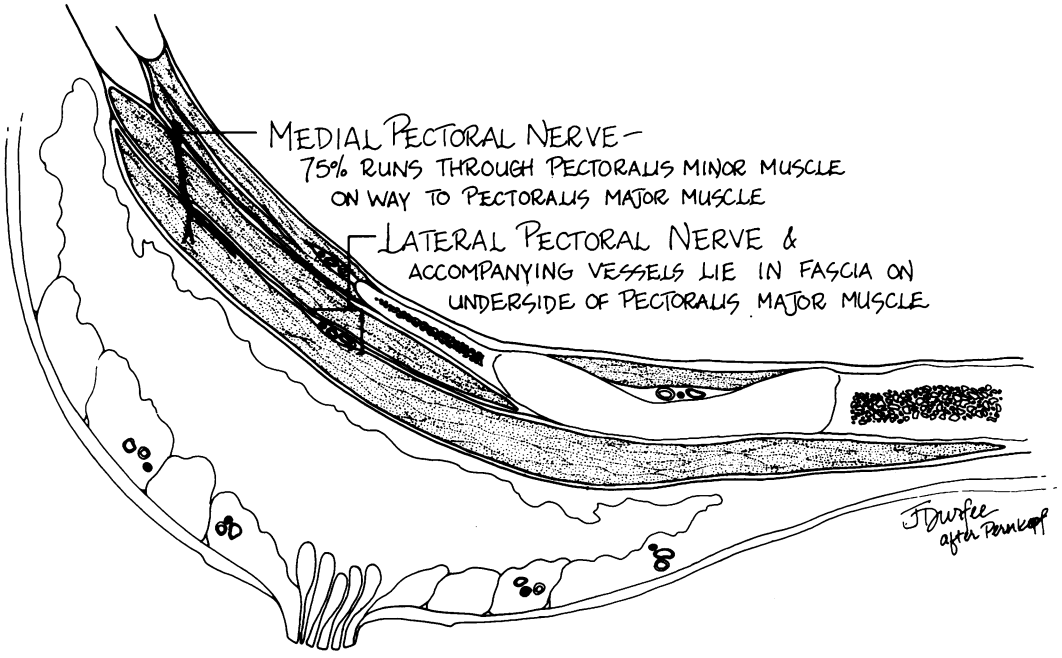

FIG. 2. Cross-section through the PMM and pectoralis minor muscle showing the lateral pectoral nerve(s) and vessels on the undersurface of the PMM and the medial pectoral nerve transversing the pectoralis minor muscle and entering the undersurface of the PMM. Reprinted by permission, from Pernkopf E. Atlas of Topographical and Applied Human Anatomy, 2nd Ed. Munich: Urban and Schwarzenberg, 1980. The drawing has been adapted.

tion in a dual-nerve innervated muscle explains the clinical entity of varying degrees of atrophy of the PMM after various types of MRM and improved projection with time in the patient who has cosmetic subpectoral augmentation.

Discussion

In patients who have MRM, the surgeon should be aware of the anatomic distribution of these two nerves. In many cases, little atrophy occurs when the medial pectoral nerves are completely transected. However, if a surgeon removes the pectoralis minor muscle and performs an extensive dissection in the axilla, particularly attempting to remove the most apical nodes, he may well injure the lateral pectoral nerve as well.

As a practical matter, this is not a common problem. However, it is worth emphasizing that there are vessels (Fig. 1) coursing with the lateral pectoral nerve beneath the PMM on its undersurface. If these vessels are disrupted, clamped and ligated, or electrocoagulated, the adjacent nerve(s) may be injured. This could result in total deinnervation of the PMM either temporarily or permanently.

Patients with atrophy of the PMM may still have reconstruction with breast implants or tissue expansion followed by breast implants. However, with the technique of skin-muscle flaps, particularly the use of the rectus abdominis flap, the problem of significant subclavicular depression is best corrected.

In his 1980 paper Dr. Darvan Moosman[7] pointed out that in 100 cadaver dissections, the medial pectoral nerve coursed through the pectoralis minor muscle in 62% of the dissections, whereas in the remaining 38% the nerve exited around the lateral aspect of the pectoralis minor muscle. Our findings were essentially the same. Thus, if the surgeon dissects between the PMM and pectoralis minor muscle, he is likely to disrupt a portion of the innervation to the PMM.

In the case of the patient who has MRM, partial deinnervation in most instances is not a problem in reconstruction, but can be if both nerves are disrupted. In the case of the cosmetic patient who has SPA, we believe the partial deinnervation is of value since a slight weakening of the lower half of the PMM in itself allows a better projection and a better cosmetic result.

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