

SCALENUS NEUROCIRCULATORY COMPRESSION

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ATTENTION was first called to the importance of the scalenus anticus muscle in the cervical rib syndrome by John B. Murphy,¹ in 1905. Apparently, he did not fully appreciate the therapeutic value of his observation for he did not suggest cutting the muscle as a step in treatment of this anomaly. Adson and Coffey² were the first to propose sectioning the scalenus anticus muscle for the relief of symptoms produced by supernumerary ribs. Their contribution has stood the test of time and is now the accepted procedure for treatment of this disorder. That the symptoms of cervical rib do occur in patients in whom no supernumerary rib can be demonstrated is a matter of common clinical experience. Naffziger,³ however, recognizing the possibility that these symptoms occurring in the absence of a cervical rib might be a definite clinical entity, sectioned the anterior scalenus muscle in a number of his patients, and obtained complete relief of symptoms. He considered the symptoms to be due to compression of the artery and plexus between the scalenus muscle and the first rib and called it the "scalenus syndrome." Naffziger told many of his neurosurgical colleagues of his observation, and talked of the disorder before medical meetings, but did not publish his observations upon the subject until January, 1937. Ochsner, Gage, and DeBakey,⁴ meanwhile, though giving full credit to Naffziger as the originator of the idea, published the only complete, authoritative, treatise on the subject, in 1934.

Our purpose in presenting this report is to review the data assembled from 20 cases of scalenus compression, without cervical rib, which have been treated surgically. We are proposing the name "scalenus neurocirculatory compression" instead of "scalenus syndrome" because we feel it more accurately describes the underlying pathologic anatomy.

Anatomy of the "Scalenus Angle" (Fig. 1).—The scalenus anticus muscle passes downward and slightly lateralward beneath the clavicle and is inserted into the scalene tubercle of the first rib. The phrenic nerve courses over this muscle from its lateral border above to its medial border below, leaving the medial edge of the muscle near its insertion to pass into the root of the neck. The angle made by the muscle and the portion of the first rib lateral to it is an acute one due to the downward direction of the first rib. The subclavian vein emerges from the thorax to pass over the first rib medial to the insertion of the scalenus anticus muscle. The subclavian artery, however, passes beneath the muscle to emerge in the vertex of the angle described above before passing over the first rib. The brachial plexus lies in the scalenus angle immediately lateral to the subclavian artery. The first thoracic and eighth

cervical nerves pass slightly downward, deepest in the angle, and over the first rib to bend rather sharply in coursing to the arm. The seventh, sixth, and fifth cervical nerves have a more downward course in inverse order, do not pass as deeply into the scalenus angle, and do not have to change their direction so markedly because of their already downward direction (Fig. 1). It may be of importance that subclavian arteries vary in the height at which they take their origin and in the height to which they ascend in the neck before passing into the scalenus angle. Variations include the piercing of the scalenus anticus muscle by the subclavian artery, or a separate slip from the muscle may pass posterior to the artery. The subclavian artery may be accompanied by the subclavian vein, or the normal position may be reversed.

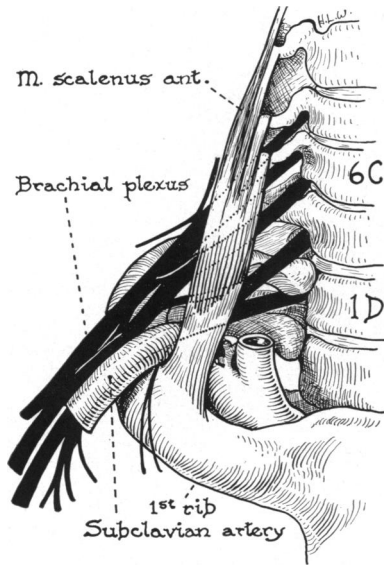


FIG. 1.—Diagram illustrating the anatomic relationship between the scalenus anticus muscle, first rib, subclavian artery and brachial plexus.

The separation of the subclavian artery from its accompanying vein is a situation which finds no analogy elsewhere in the human body. It seems reasonable to assume that earlier in the evolutionary development the subclavian artery and vein were together, but that as the scalenus angle developed, the subclavian vein became constricted and collateral veins developed superficial to the muscle; the subclavian vein now represents these collaterals.

Incidence.—Scalenus neurocirculatory compression is a relatively common clinical entity. In a period of two years we have seen 20 cases which were confirmed by their response to surgical treatment. As the diagnostic criteria become more generally known, there will be an increasing number of instances recognized. These 20 cases were equally divided between the sexes. Age was apparently not a factor, the youngest patient being age 17, and the oldest

age 67. In 11 cases the right side alone was involved, in six the left, and in three both sides. The occupations were varied and are apparently irrelevant.

TABLE I

SUMMARY OF DATA FROM 20 CASES WITH SCALENUS NEUROCIRCULATORY COMPRESSION THAT WERE TREATED SURGICALLY

Case Number	Initials	Race	Sex	Age in Years	Trauma	Duration of Symptoms	Degree of Disability	Subj. Weakness	Obj. Weakness	Numbness	Pain	Obj. Sensory Ch.	Immed. Result	Late Result
1.	O. J. L.	W.	F.	42	-	3 yrs.	Slight	+	+	-	+	+	Good	Well
2.	W. A. R.	W.	M.	31	+	12 yrs.	Severe	+	+	+	+	+	Good	Well
3.	J. E. I.	W.	M.	57	-	37 yrs.	Severe	-	±	+	+	+	Improved	Well*
4.	M. W.	W.	F.	31	-	2 yrs.	Slight	-	+	+	-	+	Good	Well
5.	H. R.	W.	M.	18	+	3 mos.	Slight	-	+	+	+	+	Good	Well
6.	W. J.	W.	M.	43	-	9 mos.	Moderate	+	+	+	+	+	Good	Well†
7.	M. B. G.	W.	F.	39	±	3 mos.	Moderate	+	+	+	+	+	Good	Well
8.	J. T.	W.	M.	51	+	1 mo.	Severe	+	+	+	+	+	Improved	Well
9.	F. R.	W.	M.	67	-	1 mo.	Severe	+	+	+	+	+	Improved	Unknown
10.	M. D.	W.	F.	27	-	3 yrs.	Severe	+	+	+	+	±	Improved	Well†
11.	W. B.	W.	M.	55	±	3 mos.	Moderate	+	+	+	+	+	Improved	Well
12.	I. B.	W.	M.	17	+	2 wks.	Complete	+	+	+	-	+	Improved	Well
13.	V. L. P.	W.	F.	50	-	2 wks.	Severe	+	+	-	+	+	Improved	Well
14.	H. E. R.	W.	M.	34	±	3 wks.	Complete	-	+	+	+	+	Improved	Well
15.	M. F.	W.	F.	22	-	2½ yrs.	Slight	+	+	-	+	+	Good	Well
16.	L. G.	C.	F.	38	±	3 mos.	Severe	+	+	+	+	+	Good	Unknown
17.	C. H.	W.	F.	59	+	9 mos.	Complete	+	+	+	+	+	Improved	Improved
18.	W. P. T.	W.	M.	35	-	4 mos.	Severe	+	+	+	-	+	Good	Well
19.	D. N.	W.	F.	29	-	3 wks.	Moderate	+	+	+	-	+	Good	Well
20.	M. H.	W.	F.	26	-	2 yrs.	Moderate	-	±	-	+	±	Good	Well

* Patient made a complete recovery but died two months later following an appendectomy.

† Minimal residual symptoms with no disability.

Symptoms and Signs (Table I).—As would be expected, the symptoms of scalenus neurocirculatory compression are those of cervical rib, and show the same variability. The symptoms referable to direct involvement of the brachial plexus are of the most diagnostic importance. Usually the medial cord of the plexus is involved alone, or most severely. Thus the pain, paresthesiae, and various degrees of sensory impairment are most apt to affect the ulnar distribution (or the dermatomes of CvIII and D1), and, if present in the median and radial distributions also, will be most severe in the ulnar. Correspondingly, the small muscles of the hands, the flexors of the fourth and fifth digits, the flexors of the remaining digits, and the flexors of the arm, are usually involved in approximately this order before the extensors become affected.

Pain was present in all except four cases. In addition to the pain which occurred in the area supplied by the brachial plexus, it was also occasionally present in the deltoid region, supraclavicular fossa, neck, or localized to the region of the seventh cervical spine.

It is entirely possible that degrees of compression of the artery which do

not affect the circulation enough to be detected may cause pain through the afferent nerves from the artery. The corollary of this may also be true in some instances—that is to say, the circulation of the upper extremity may be affected by involvement of the vasomotor nerves in the brachial plexus without any arterial compression.

Numbness or Hypo-esthesia occurred in all 20 patients. The ulnar distribution was chiefly affected, although several cases showed impairment of the median distribution and two showed impairment of sensation primarily in the radial distribution.

Muscular Weakness of some degree was present in every case, although in two cases it was so slight that it was considered questionable. The weakness had been noted by the patient in most, but not all, instances before the motor power was tested. Usually the flexors of the fingers were affected along with the intrinsic muscles of the hands. In one unilateral case and in one bilateral case, definite atrophy of the intrinsic muscles of the hands was noted.

Pulse.—This was diminished in one case, and barely perceptible in another. In the latter instance the blood pressure could not be obtained on the affected side, and the extremity was cool and pale-purple in color. One case with a normal pulse had a cool, edematous hand, but this case was complicated by a definite arthritis. By having the patient turn the head toward the involved side and take a deep breath, the radial pulse was obliterated or considerably diminished in all except three cases. It was possible to obliterate the pulse by pressure over the scalenus anticus muscle in every instance. Often slight pressure was sufficient. It must be borne in mind, however, that the pulse can be obliterated in this way in many normal individuals.

Scalenus Tenderness was a very constant finding and of great help diagnostically. Pressure was made over the scalenus muscle just above the clavicle, and the two sides compared relative to the degree of their sensitivity to pressure. In about one-half the cases this maneuver caused, in addition, radiation of tingling or pain down the arm, usually in the ulnar distribution.

Pathology.—It was noted at operation, that in some cases the scalenus anticus muscle was large and very tense. Beneath it, there frequently appeared to be tough, fibrous bands which may, at times, have been a thickened, tendinous posterior covering of the muscle. In addition, there were in some instances bands passing beneath the subclavian artery which were attached to the first rib. These may have represented variations in the scalenus anticus muscle or bands passing from the transverse process of the seventh cervical vertebra to the first rib, similar, embryologically, to a cervical rib.

Specimens of the scalenus anticus muscle were submitted to microscopic examination in seven cases. There was an arteriosclerosis of the small arteries in four cases and moderate fibrosis in two. These findings, however, were not considered to be of great significance.

Etiology.—Many explanations have been suggested to explain why, in cases of known cervical rib, many have symptoms only late in life, and many

never have any indication of brachial plexus involvement. The shoulder girdle is situated higher in youth, gradually descending as age progresses, thereby forcing the brachial plexus farther into the scalenus angle. The shoulder on the dominant (usually right) side drops lower in adults than on the other side, thus predisposing to a brachial plexus involvement on this side. We feel that the mechanism which initiates the symptoms in cases of scalenus neuro-circulatory compression is much the same as in cases of cervical rib. In the group of unilateral cases, 11 involved the right side and six, the left, a right-sided predominance as has been noted in instances of cervical rib. However, our cases were divided equally between the sexes, although symptoms from cervical rib predominate in women, due to the fact that their posture allows the shoulder girdle to drop lower than in men.

Definite trauma has, apparently, precipitated symptoms in five of the cases; and in two additional cases, both women, the unaccustomed throwing of a soft ball initiated the symptoms. The rôle of trauma is so important that two cases are presented to more fully illustrate the relationship.

Case 1.—I. B., white, male, age 17, was perfectly well until January 7, 1937, when, while carrying a 75 pound cake of ice on his back, he felt as though something gave way in his right shoulder. This was not accompanied by severe pain, nor did any severe pain occur later. Within two hours his right upper extremity became weak, cold, and numb. Examination one week later revealed a definite tenderness on pressure over the right scalenus anticus muscle; diminished pulse at right wrist, which was diminished still further by turning the head to the right and taking a deep breath, and was entirely obliterated by pressure over the right scalenus anticus muscle; paresis of the entire right upper extremity; profound ulnar and slight median hypo-esthesia. Two weeks after he was first seen the symptoms had become still further advanced, and a section of the right scalenus anticus muscle was performed under local procain anesthesia. Immediately after the muscle and the bands beneath it were divided, the patient felt an improvement in the numbness of his hand and arm. The motor weakness rapidly disappeared during the following week, and the patient has remained free of symptoms.

Case 2.—W. A. R., white, male, age 31, sustained a rather severe injury to his neck and left shoulder region while playing football, in 1924, since which time he has had vague pains in this area. In 1929, there was transient numbness in the ulnar nerve distribution, and from time to time some weakness of the left arm. On May 8, 1936, the patient wrenched his neck by being thrown against the roof of his automobile. Severe aching pain in the left shoulder persisted for 36 hours and was followed by progressive weakness in the left hand and numbness in the ulnar side of the left hand and arm.

Examination elicited marked tenderness over the left scalenus anticus muscle. Pressure upon it or depression of the shoulder caused tingling paresthesiae down the ulnar distribution. The circumference of the left forearm was 2 cm. less than on the right side. There was marked weakness of the left grip, and to a less extent of the whole left arm. Roentgenologic examination was negative for cervical rib.

Two weeks later a further progression of symptoms was noted, and the scalenus anticus muscle was sectioned. There was a fibrous band beneath it, constricting the subclavian artery. There was immediate improvement in the motor power of the left hand; the numbness disappeared; the patient has remained completely free of symptoms.

Treatment.—We have seen a number of cases of scalenus neurocirculatory compression with symptoms so mild that surgery was not suggested. Relief has been obtained by using a figure-of-8 bandage about the shoulders or by

elevating the elbow by means of a sling. Nocturnal symptoms have frequently been prevented by having the patient sleep with the affected arm above the head. Relief by these measures is of diagnostic aid. Probably many of these mild cases will have to be operated upon eventually, however. We have operated upon only those cases in which the symptoms caused disablement to a moderate or severe degree.

The bilateral cases should be operated upon on one side at a time, because of the inevitable phrenic paralysis or paresis following anterior scalenotomy. In instances where it was not even necessary to retract the phrenic nerve, paralysis has occurred just the same. It is possible that the springing apart of the stretched muscle after cutting makes sufficient traction upon the phrenic nerve to impair its function. The phrenic paralysis has been found to disappear in about six weeks.

Operative Technic.—An incision 4 cm. long is made 2 cm. above the clavicle, parallel with it, overlapping the lateral edge of the sternocleidomastoid muscle. It is usually possible to avoid the external jugular vein. The platysma is divided and the clavicular portion of the sternocleidomastoid muscle retracted medially. Ordinarily, the posterior belly of the omohyoid muscle can be retracted; if not, it is cut. The deep fascia is divided, care being taken to identify the transverse cervical vessels or other large vessels which may be present, and the scalenus anticus muscle becomes exposed. At the level of this incision the phrenic nerve, as a rule, courses along the medial edge of the muscle. A small portion of the muscle beneath the phrenic nerve is separated with it in order to protect it and is then either retracted or allowed to retract medially. Usually the internal jugular vein is exposed medially, appearing beneath the sternocleidomastoid muscle.

The scalenus anticus muscle is separated from the deeper structures by placing a retractor beneath it. It is sectioned piecemeal. Care is taken to sever completely the tendinous posterior covering of the muscle and any fibrous bands passing beneath it. Palpation within the wound frequently reveals the presence of bands which cannot be seen. In this way part of the brachial plexus is exposed and usually the subclavian artery, although at times the latter can be palpated only behind the clavicle. After careful hemostasis, a small rubber tissue drain is left in the dead space, and the deep and superficial fasciae, and skin are closed with separate rows of interrupted silk sutures. The drain is removed after 12 to 24 hours.

Prognosis and Results.—The immediate result of operation was good in all 20 cases. Many recovered normal sensation and relief from pain while still on the operating table, while others required several days or weeks. Improvement in motor weakness was equally prompt in some instances, and slower in others. One of the bilateral cases, in which an excellent result was obtained, died three months postoperative, following an appendectomy. Two cases could not be traced. Of the remaining 17 cases, all are without symptoms with three exceptions. One has annoying paresthesiae in the ulnar nerve distribution, but his pain, weakness, and hypo-esthesia have disappeared. In

the second case there is occasionally a tired feeling on the operated side, with some guarding of this arm, but the patient works regularly and is free from pain. The third case was complicated by an arthritis of the hand and shoulder. The ulnar hypo-esthesia and weakness of the hand, however, have disappeared. The pain in the shoulder has improved somewhat, but is still disabling. Since this case is only three weeks postoperative, it is hoped that the arthritis may have been secondary to circulatory changes due to scalenus compression and may yet clear up.

DISCUSSION.—That trauma about the neck or shoulder does precipitate compression within the “scalenus angle” naturally leads to many interesting speculations. Probably some patients who have been considered to have had torn brachial plexuses, or avulsed roots of the plexus from direct trauma to the arm or shoulder may have nothing more than scalenus compression. We have seen two such cases not included in this report—one of them several weeks after the injury and one almost a year after—who had the usual signs of scalenus compression. Both, however, had complete peripheral nerve lesions. Section of the scalenus anticus muscle improved the circulation but did not improve the paralysis. In both cases the plexus was demonstrated not to have been torn. Also, some of the brachial birth palsies, particularly those which do not have an accompanying Horner’s syndrome, may be due to this lesion. So far, we have had no opportunity to observe newborn infants of this type.

“Neuritis” is one of the more frequent of human ailments. If we eliminate from consideration those cases of frank polyneuritis of infectious, chemical, deficiency, or toxic origin, we find in most instances pain and disability limited to one arm or one leg. When pathology in the joints is ruled out, such pain in the arm and shoulder is commonly termed “brachial neuritis” and in the leg “sciatica.” It is unnecessary for us to review the unsatisfactory methods of treatment which have been available for these chronic cases of “neuritis” in the past. Fortunately, in recent years a better understanding of the underlying causes of a painful arm or leg has come about, especially in the latter case. Nowadays the patient with sciatic pain is properly studied from the point of view of mechanical compression of the nerve or its component roots. In most of the chronic cases one is able to demonstrate a lesion within or of the spine, or in the course of the sciatic nerve. Once the cause is found, treatment can be directed to the cause rather than to the relief of the symptom.

In cases with arm pain, our knowledge is in a more nebulous state. After arthritis of the shoulder joint, diseases of the bursa or tendons about the shoulder, and cervical ribs have been eliminated, we have formerly often been forced to conclude that the patient suffered with “neuritis” of unknown etiology. A more general appreciation of the signs and symptoms of compression within the “scalenus angle” will, doubtless, clarify many of the cases of unexplained brachial neuritis. From our experience we feel that it is probably one of the most common causes of the painful arm and shoulder.

REFERENCES

- ¹ Murphy, John B.: A Case of Cervical Rib with Symptoms Resembling Subclavian Aneurysm. *ANNALS OF SURGERY*, 41, 399, March, 1905.
- ² Adson, A. W., and Coffey, J. R.: Cervical Rib. *ANNALS OF SURGERY*, 85, 839, 1927.
- ³ Naffziger, Howard: Scalenus Syndrome. *Surg., Gynec., and Obstet.*, January, 1937.
- ⁴ Ochsner, A., Gage, M., and DeBakey, M.: Scalenus Anticus (Naffziger) Syndrome. *Am. Jour. Surg.*, 28, 669-695, June, 1935.

DISCUSSION.—DR. R. ARNOLD GRISWOLD (Louisville, Ky.).—Doctor Spurling has brought out the traumatic origin of many of these cases. This is becoming increasingly important from the medicolegal standpoint. I should like to put two such cases on record. The first was a roofing worker who fell from a ladder, falling ten feet and then catching the ladder, bearing his full weight on that arm. He immediately experienced pain which subsided, but was followed in 24 hours by severe pain and paresthesia on that side. He was relieved by operation.

The second case was a woman who was riding in the back seat of an automobile, saw that a collision was impending, and reached over the seat to catch her child. She was in this position when the accident occurred, and had immediate pain over the clavicle. Within a few days there was pain, paresthesia and a typical scalenus syndrome. She was relieved by operation. Interestingly enough, both these cases were accepted by insurance companies as being traumatic in origin.

A third patient who was operated upon three years ago for pericarditis has as a result a soft spot over the heart. Unconsciously, in order to protect this soft spot this patient drops his shoulders forward. Two years after operation he began to develop a scalenus syndrome on both sides; the etiologic factor here being, apparently, the result of a defective posture.

DR. KENNETH AYNESWORTH (Waco, Texas).—I am very much interested in this paper because I have a daughter who has this in a mild form on both sides, and my next-door neighbor was operated upon for bilateral scalenus neurocirculatory compression. I have asked this question of every patient I have seen: "How do you sleep?" Without exception, all of them have said, "I have to sleep with my hands over my head." I would like to emphasize that fact. One patient, a farmer, who has developed this trouble, states that he has to sleep with the right arm over his head to obtain comfort. Another patient, a woman, age 64, fell downstairs, striking her right shoulder, and suffered pain in the right side of the neck and shoulder for some weeks. On a long automobile trip she had to give up driving because of the pain in the right side of the neck and down the right arm; it was felt along the distribution of the ulnar nerve and was associated with some edema and paresthesia of the entire arm. Within a month, she was absolutely unable to use the right arm. An internist diagnosed arthritis and neuralgia and put the arm in a plaster splint, which gave some temporary relief but the pain soon became worse. In consultation I made a diagnosis of scalenus syndrome. The operation was performed under local anesthesia in the morning and when I came back to see her in the afternoon she reached out and shook hands with me, a thing which she had not been able to do for four months. There has been no return of her discomfort.