SUPRACLAVICULAR FIRST RIB RESECTION FOR TREATMENT OF THORACIC OUTLET SYNDROME

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ABSTRACT

Twelve patients with thoracic syndrome were operated during a 15 month period. Eleven patients had features of neurogenic thoracic outlet syndrome, while one presented with arterial ischemia due to distal embolism. The diagnosis was based on the characteristic history and positive stress tests. Cervical rib was present in 7 patients. Abnormal nerve conduction studies were present in 7 out of 8 cases. Supraclavicular first rib resection was done in all patients in view of the severity of symptoms. If present, the cervical rib was also excised. There was no major operative complication. Eleven out of twelve patients reported relief of symptoms. Thoracic outlet syndrome is not an uncommon disorder and often goes undiagnosed. Resection of first rib via the supraclavicular approach gives good results in majority of the patients who have incapacitating symptoms.

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KEY WORDS : Thoracic outlet syndrome; Cervical rib syndrome.

Introduction

Pain in the upper limb as a result of pressure by the first-rib was first reported in 1910 by Murphy [1]. This syndrome was labelled as thoracic outlet syndrome (TOS) by Peet in 1956 [2]. The patients may have any of the three types of symptoms: neurogenic, arterial or venous [3]. The neurogenic symptoms consist of pain and weakness in the upper limb. Ischemia of the hand due to embolization from a post-stenotic dilatation of subclavian artery is the commonest arterial manifestation. Swelling of the arm due to compression or thrombosis of axillary vein is rare. Cervical rib is the culprit in over half the cases, causing compression of the brachial plexus or the subclavian vessels as they exit at the root of the neck.

The diagnosis is based on the characteristic history and a positive stress test: the more common are the Adson's test [4], the hyperabduction test, the costoclavicular manoeuvre, or the elevated arm stress test [3]. Nerve conduction studies are often abnormal in these patients. Severe persistent

symptoms necessitate surgery. Several operative measures have been tried: scalenotomy, cervical rib excision or first rib resection. The latter is currently in vogue [5] as it widely decompresses the thoracic outlet. This operation may be performed by a trans-axillary, posterior, or supraclavicular approach. This report presents our experience with the first-rib resection via the supraclavicular approach in the management of TOS.

Materials and Methods

Twelve consecutive patients with severe TOS were taken up for supraclavicular first-rib resection at Command Hospital (SC), Pune between March 1994 and May 1995. Ten patients were female and two male. The mean age was 29 years (range 18-45 years). The average duration of symptoms was 18 months and all of them had failed to respond to intensive conservative measures. Eleven patients had neurogenic TOS with pain, weakness and/or wasting of small muscles of hand. One patient had arterial symptoms in the form of embolism to index and middle fingers, and

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absent radial pulsation. Radiographs demonstrated cervical rib in 7 cases; this was bilateral in three patients. Stress tests were positive in 11 out of 12 patients (Table 1). A supraclavicular bruit was present in 2 patients. Nerve conduction studies were done in 8 patients and an abnormality in ulnar nerve sensory conduction was present in 7 patients (Table 2). Arteriography was done in one patient. This showed a stenosis of subclavian artery with a post-stenotic dilatation. MRI was performed in one patient to exclude cervical disc lesion. The first-rib was excised in all patients. The operation was performed under general anaesthesia. A supraclavicular approach was used in every case. The scalenus anterior muscle was divided after identification and protection of the phrenic nerve. The subclavian artery was taped up. The brachial plexus was identified and the nerve roots carefully protected. The Sibson's fascia and the underlying pleura was reflected medially and the first rib freed of all attachments. Any abnormal fibrous or muscular bands were divided. Extraperiosteal resection of the first rib was done using a Gigli saw and a bone cutter/nibbler. The integrity of pleura was tested and the wound closed after leaving a suction drain. Post-operative antibiotics were not used routinely.

Results

Cervical rib was present in 7 patients and this was excised. One patient had stenosis of the subclavian artery with a post-stenotic dilatation due to compression by the first rib. The dilated portion of subclavian artery was excised and a subclavian-axillary bypass was done using reversed saphenous vein. Sclenus anterior muscle was found compressing the neurovascular structures in 2 patients. Additional myofascial slip was causing neurogenic compression in 1 patient. An abnormally broad first rib was deemed to be the offending compressing structure in one case. Brachial plexus roots were adherent to surrounding structures in 3 patients; neurolysis was therefore performed. Details of ancillary procedures performed along with the first-rib resection are listed in Table 3.

The average operating time was 150 minutes (range 90-210 minutes). The blood loss was less than 300 mL and none of the patients required any transfusion. There was no mortality. The average

TABLE 1

Stress test for thoracic outlet syndrome

Name of the test	Positive in (Total 12 patients)
Adson's test	5
Hyperabduction test	8
Costoclavicular manoeuvre	2
Elevated arm stress test (EAST)	10

Note : Most patients had more than one test positive

TABLE 2

Abnormal nerve conduction studies in TOS

Patient's age/sex	Nerve	SNCV (m/sec)		Amplitude SNC (μ V)	
		control side	affected side	control side	affected side
1. 18/F	Ulnar	52.2	37.9	6.00	1.20
2. 35/F	Ulnar	72.0	57.3	5.68	0.24
3. 19/F	Ulnar	55.6	50.0	4.08	0.84
4. 39/F	Ulnar	56.6	48.8	4.40	0.50
5. 28/M	Ulnar	52.2	47.7	4.88	0.66
6. 37/M	Ulnar	57.4	43.6	5.02	1.72
7. 32/F	Ulnar	54.2	45.8	4.36	0.94

SNCV : Sensory nerve conduction velocity; SNC : Sensory nerve conduction

TABLE 3

Ancillary procedures with first-rib resection

Nature of procedure	Number of patients
Cervical rib excision	7
Ligation of subclavian aneurysm and subclavian - axillary bypass	1
Scalenectomy	2
Brachial plexus neurolysis	3

post-operative stay was 8 days (range 5-15 days). The pleura was accidentally opened in one patient and was managed by an underwater seal drainage for 48 hours. The patient made an uneventful recovery. One patient had phrenic nerve palsy. This recovered after 3 months. One patient had post-operative wound infection necessitating antibiotics and drainage.

Follow-up of up to 18 months revealed that 10 of the 12 patients were completely relieved of their symptoms, while one had only partial relief. Symptoms persisted unchanged in one patient.

None of the patients worsened after the procedure.

Discussion

The thoracic outlet is a narrow space through which the brachial plexus and the subclavian vessels pass from the root of the neck to the arm. It is bound inferiorly by the first rib, posteriorly by the scalenus medius and anteriorly by the scalenus anterior, subclavius and the clavicle. TOS, also known as the scalenus anterior syndrome, the costoclavicular compression syndrome, the hyperabduction syndrome, and the costoscalene syndrome is a distinct entity, but it has unfortunately not received the attention that it deserves. The exact incidence is probably unknown but those managing these patients have reported fairly large series. Cervical rib which is present in 0.17 - 0.74 per cent of normal population [6] was the first structure implicated in its etiology [7]. However it was soon realized that TOS could be caused by a normal first rib [1]. The scalenus anterior muscle [4], the scalenus medius muscle [8], the scalenus minimus muscle [9], the clavicle and subclavius muscle [10] and a host of other congenital myofascial anomalies [11] may account for this syndrome. Faulty posture and the sagging of shoulders have also been blamed. The syndrome may present with predominantly neurological or arterial or venous symptoms; the former is said to account for 95 per cent of the cases [5]. The neurogenic TOS accounted for 91 per cent of our cases. Arterial complications are rare [12]; they were present in only 9 per cent of our cases.

The diagnosis is suspected by the characteristic history [5] and is confirmed by one of the stress (provocation) tests [4,11]. These tests were positive in 91 per cent of our patients, with the elevated arm stress test being the most specific, with a 83 per cent positivity [3]. The role of nerve conduction studies in the diagnosis of TOS is controversial, with some reporting an excellent correlation, while others finding them of little use. The delay in ulnar nerve conduction is often present [13], and this was present in the 7 of our 8 patients subjected to electrophysiological studies. Sensory potential amplitudes may also be diminished [14], and this was confirmed in our study. Angiography is recommended only for evaluation of patients with vascular symptoms, and should not be used as

a diagnostic test for neurogenic TOS. The role of CT scan and MRI in the diagnosis of TOS is as yet undefined however they are useful to excluded lesions of cervical spine where diagnosis is uncertain [5].

The differential diagnosis of TOS includes other nerve compression syndromes like the carpal tunnel syndrome, cervical spine pathology (spondylosis, disc prolapse), shoulder disorders (rotator cuff injury, myositis) and rarely other conditions like angina. The variety of other conditions that can be confused with it is illustrated by the fact that one 18-year-old female in our series was diagnosed as a case of Hansen's disease and another 2 females were having psychiatric consultation for their symptoms. All of them recovered completely after first-rib resection. The consequences of labeling these young patients with these diagnoses can be tragic and psychologically devastating for the patients as well as their families.

A large number of patients with TOS may respond to conservative measures consisting of NSAIDS, correction of faulty posture and specific exercises aimed at strengthening the shoulder girdle muscles [2]. Surgical treatment should be offered if symptoms are severe and persist despite conservative treatment. Several options exist: excision of the offending cervical rib was the first operation described to relieve the symptoms [7] but it is rarely performed as the sole procedure as the symptoms recur in up to 30 per cent of cases. Scalenotomy, described in 1927 by Adson still has its advocates though the recurrence rate is again very high when this is used as an isolated procedure. The rationale of first-rib resection is that it widely decompresses the thoracic outlet, and first-rib resection has been the standard treatment for TOS for over three decades. The success rate after this operation is in the range of 80-93 per cent [3]. Other procedures like pectoralis minor tenotomy [15] and claviclectomy have been tried but are rarely performed now. Our success rate of 91 per cent compares favourably with other reported series [3,16]. The first-rib resection can be performed via the supraclavicular approach [1], the transaxillary approach popularised by Roos [17], the posterior thoracotomy approach [18], or the infraclavicular approach [19]. A combined supraclavicular and transaxillary approach has also

been described [20]. In practice, however, only the transaxillary and the supraclavicular approaches are popular, with the proponents of either approach claiming advantages. Transaxillary operation is relatively simple and easy to learn and complications are said to be low [17]. However the exposure of subclavian artery and vein is poor and if the vessels are accidentally damaged during operation, the haemorrhage may be impossible to control. This approach is thus unsuitable for patients with vascular symptoms of TOS. An additional disadvantage is that scalenectomy cannot be performed and neurolysis of brachial plexus is not feasible. However Roos [3,11,17] has been such a forceful proponent of this operation that it was the standard approach in the seventies and eighties. The advantages of the supraclavicular approach are that it affords direct exposure to all anatomic conditions that cause TOS, extensibility of incision for proximal control of vessels, arterial reconstruction is easy, scalenectomy can be performed and brachial plexus neurolysis can be performed under vision [5]. Our success rate of 91 per cent with no major complications attests to the safety and efficacy of this approach. The only trial comparing the transaxillary and the supraclavicular approaches [16] has, interestingly, found the same success rate with both these approaches.

TOS is a not uncommon yet not so well known syndrome which presents as neuralgic pain in upper extremity. Diagnosis is based on the typical history and positive stress tests. Nerve conduction studies are useful supporting evidence in the diagnosis. First-rib excision by the supraclavicular approach alleviates the symptoms in a large majority of chronic refractory cases.

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