CLINICAL STUDY

Thoracic outlet syndrome – 24 years of experience

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Abstract

Objectives: **Determine the outcomes of first rib resection for thoracic outlet syndrome.**
Background: **Thoracic Outlet Syndrome is not a very frequent syndrome, affecting especially young patients, predominantly women. Its symptomatology is caused by compression of a nervous and vascular plexuses in a physiological isthmus in the upper thoracic aperture. Types of TOS can be neurogenic (95 %), arterial (3–5 %), or venous (2 %).**
Methods: **Retrospective study was done at the 2nd Department of Surgery of St. Anne's University Hospital Brno, between the period 1982–2006, i.e. within 24 years. During this time 141 patients were operated on. Information gained was compared with the Czech vascular register.**
Results: **Between 1982 and 2006, i.e. within 24 years, 141 patients were operated on. Out of a group of 100 patients in whom simple first rib resection was performed, re-operation after 2 years was necessary in 3 patients because of the same problems as before the operation (3 % of the patients). In these patients, symptoms occurred in 3–12 months after the first operation.**
Conclusion: **Initially, the treatment should always be conservative (rehabilitation), unless there is an acute vascular event. In case that rehabilitation treatment failed and the cause of TOS was proved, we recommend surgical treatment. Treatment of TOS is multidisciplinary *(Fig. 2, Ref. 8)*. Full Text (Free, PDF) *www.bmj.sk***
Key words: TOS; history; diagnostics; conservative and surgical treatment.

Thoracic Outlet syndrome (TOS) is caused by compression of a nervous and vascular plexuses in the area of the upper thoracic aperture.

The previously reported and separately described syndromes such as cervical rib syndrome, scalenus syndrome, hyperabduction syndrome, costoclavicular syndrome and others were brought together to be termed TOS in the 1960's.

The causes of these syndromes are compression of the nervous and vascular plexuses in physiological isthmus at the upper thoracic aperture, or some congenital anomalies. Anatomical structures of this area – scalene muscles, clavicle, the first rib, fibrous bands, insertion of the pectoralis minor muscle or subclavian muscle, cervical rib, or post-traumatic changes – take part in it. Various structures can be affected by compression, such as the brachial plexus, subclavian artery or axillary artery, subclavian vein or axillary vein. In the isthmus area, they can be affected individually or in combination.

Accordingly we talk about neurogenic (95 %), arterial (3–5 %), or venous (2 %) TOS.

First reports in medical literature on the compression syndrome occurred at the beginning of the 19th century. In 1821, Cooper described a subclavian artery thrombosis caused by cervical rib as the cervical rib syndrome. In 1861, the first cervical rib resection was performed. In 1943, the term costoclavicular syndrome was used for the first time in connection with the compression syndrome in the space between the first rib and the clavicle. In 1947, Adson described a compression in the scalene space, the so-called scalenus syndrome. The English term for the upper thoracic aperture compression syndrome – Thoracic Outlet Syndrome – has been used (1, 2) since 1962.

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Symptomatology

The symptoms can be divided into two groups – neurological and vascular ones.

Neurological symptoms are more frequent. They include arm and forearm pain, paresthesias, sensation loss and motor weakness. Neurological symptoms may be manifested also in the autonomic nervous system as impaired thermoregulation; in cold weather, the patients suffer finger whitening, paresthesias and cyanosis.Vascular symptoms from arterial compression include upper limb claudication during exercise, pallor, coldness, increased tiredness; impaired peripheral blood supply, microembolization and colour changes may occur. In connection with subclavian artery compression, post-stenotic dilatation and even aneurysmatic changes of the artery with possible peripheral embolizations are often described in the literature (3). With repeated compression of the artery and repeated changes of position, peripheral embolizations may occur and they are more frequent than in popliteal artery aneurysms (4). Vascular symptoms due to venous compression are often swelling, tiredness, sensation of heaviness, pain, colour changes and even subclavian vein or axillary vein thrombosis may occur with all the subsequent symptoms. We can often see the Raynaud's phenomenon.

Diagnostics

In the medical history we search for a possible foregoing trauma, excessive exercise, we take notice of the patient's posture, the character of his/her job, and we do not forget about a possible tumour disease. Clinical examination requires some essential manoeuvres. Tinel's sign is a rotation of the head to the opposite shoulder – occurrence of paresthesias on the opposite upper limb suggests a compression in the scalene space. When

performing the Kelly's test, arms are abducted and maximally stretched backwards, with elbow flection the tested person opens and clenchs with his/her fists. If paresthesias or colour changes of the limb occur within 3 minutes, it is a compression in the costoclavicular space. With the Adson's manoeuvre the patient's upper limbs lay on his/her knees. The patient takes a deep breath and turns the head to the affected side; paresthesias occurring on the limb or disappearance of radial artery pulsations on the affected limb suggest a subclavian artery and brachial plexus compression between the first rib and the scalenus anterior muscle. The hyperabduction manoeuvre is performed by abduction of the patient's arm and rotation of his/her head. At the same time we monitor the radial artery pulsation on the affected limb. If the pulsation disappears, the test is positive and suggests a compression of the artery in the insertion area of the pectoralis minor muscle. In this way, we examine both upper limbs were examined; also murmurs over arteries were auscultated in the area of the upper thoracic aperture, blood pressures on both upper limbs were compared. Among other examinations of differential diagnostis, radiography of the upper thoracic aperture was performed observing possible presence of a cervical rib, hypertrophic transverse process of the seventh cervical vertebra, position of first ribs, post-traumatic changes of the clavicle. The examination was completed with a cervical spine radiography. The respective shoulder joint was examined.

It is necessary to perform neurological examination including electromyography of ulnar and median nerves (with hyperabduction of the arm). Ultrasonography of the subclavicular area can reveal a post-stenotic dilation of the subclavian artery or even an aneurysm caused by chronic compression. If these above mentioned examinations suggest the presence of a compression syndrome, phlebography or arteriography both in resting position and in functional position with abduction were performed.

Differential diagnosis

Differential diagnosis is based on detailed medical history and detailed clinical examination including available advanced methods. Correct diagnosis requires to consider vertebrogenic radicular irritation, ulnar nerve neuropathy in the elbow area, carpal tunnel syndrome, cervicobrachial syndrome, trapezius muscle myalgia, omarthrosis, post-traumatic changes after injury to the brachial plexus, post-traumatic conditions of the clavicle, Raynaud's disease and other vasoneuroses.

Therapy

Conservative treatment

If the diagnosis of TOS is made, the treatment was decided. It is always recommend to start with conservative treatment unless subclavian artery aneurysm is revealed or peripheral embolization due to the aneurysm occurs. Rehabilitation therapy consists of elevation of the shoulder girdle, correct posture, compensation of excessive lordosis, kyphosis, and rehabilitation in patients with outstanding scapulae. It should be performed at departments with experienced staff. Due to quality rehabilitation, symptoms may disappear in up to 50 % of patients (4).

Surgical treatment

We recommend surgical treatment in case that in spite of consistent rehabilitation improvement has not been achieved and there is no chance that continued rehabilitation could result in a positive effect.

At present, according to the symptoms, first rib resection from the axillary approach is chosen which is cosmetically advantageous, and moreover fibrous bands including the cervical rib and the scalenus anterior muscle can be removed.

With this surgical approach according to Roos, upper thoracic sympatectomy can be also performed in addition to the first rib resection if Raynaud's phenomenon is present (5). We test this operation in advance by a stellate ganglion block with a local anaesthetic. A disadvantage of this approach is that the first rib resection with the scalenus anterior muscle resection is performed from a relatively small incision (12–15 cm), in great depth.

In case of complications the surgeon can experience difficult situations.

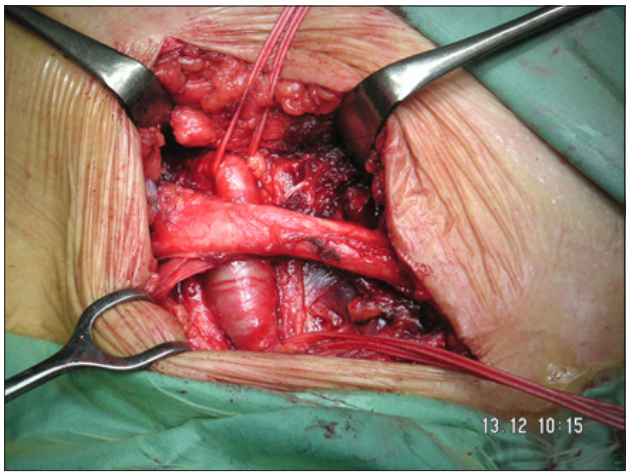

Fig. 1. Subclavian artery aneurysm caused by cervical rib and first rib hypertrophy.

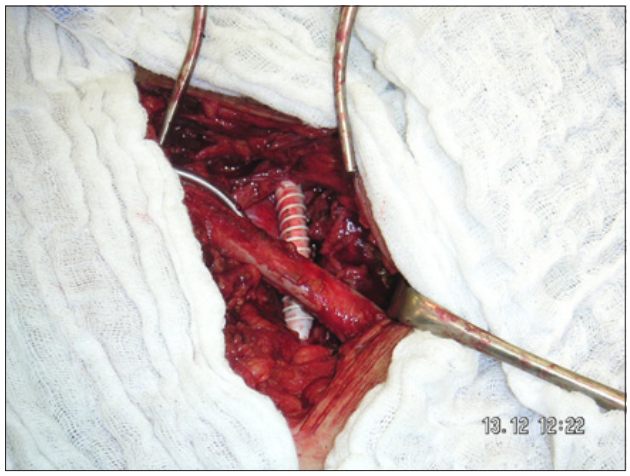

Fig. 2. Subclavian artery aneurysm replaced with a PTFE prosthesis with a spiral.

Other approaches are cervical and supraclavicular ones. They are advantageous especially in case of a subclavian artery aneurysm. It is always necessary to remove two thirds of the first rib – laterally from the sternocostal joint.

Periosteum must not be left in the wound, all fibrous bands must be consistently removed.

In case of Raynaud's phenomenon upper thoracic sympathectomy was performed via thoracotomy between the second and third ribs. The stellate ganglion is always preserved (complete or its upper part), otherwise it could cause the Horner's syndrome. We remove the second and third sympathetic ganglia, clipping individual fibres, the central part and the peripheral part of the nerves with nonmagnetic clips. This method is tried and tested and it prolongs the effect of sympathectomy. The operation requires perfect knowledge of the surgical field. During the operation damaging the brachial plexus,

phrenic nerve, subclavian artery and subclavian vein is avoided. Having finished the rib resection, we check the closure of the pleura.

In case of thoracotomy in upper thoracic sympathectomy, thoracic drainage is performed. Thoracoscopic upper thoracic sympathectomy is the method of choice. In subclavian artery aneurysms, resection of the dilated artery and replacement with an artificial vascular prosthesis (preferably a prosthesis with a spirale) is performed (Figs 1 and 2). Thrombembolectomy is carried out in case of simultaneous thrombosis or embolization of the artery.

It should be mention that procedures of interventional radiography, or thrombolysis are also increasingly used in these localities.

Postoperatively (after the patient has been transferred to the postoperative unit), chest X-ray is performed. Drains, limb mobility, and peripheral pulsations are observed. We remove the drain in 48 hours, and a possible thoracic drain as well. Rehabilitation starts on postoperative day 2.

It is a part of comprehensive treatment of this disease.

Complications

Immediate complications of the surgery are injury to the brachial plexus, long thoracic nerve, intercostobrachial nerve, injury of the subclavian artery, subclavian vein, pneumothorax, rib fracture or lymphorrhoea. Late complications are intercostal neuralgia, causalgia in the surgical wound, or development of new fibrous bands.

Methods

Retrospective study was conducted at the 2nd Department of Surgery of St. Anne's University Hospital Brno, between the period 1982–2006, i.e. within 24 years. During this time 141 patients were operated on. Information gained was compared with the Czech vascular register.

We tried to see the results of first rib resection. Some authors report that the results of first rib resections for TOS are extraordinarily good and lasting (6). In recent years, however, these very optimistic opinions have been challenged. Causes of unsatisfactory outcomes can be the following: incorrect indications for the operation, insufficient resection of the first rib dorsally, other fibrous bands left, parts of periosteum left after the rib resection, high position of the second rib. In the literature, numerous renowned departments report that 43–78 % of operated patients report good results within one year after operations for TOS. Later on, some troubles recur.

5-year satisfactory outcomes are reported in 60–65 % of cases (7). Recurrent troubles occur in 15–20 % of patients. In 3–5 % of patients, re-operation is necessary.

Results

The 2nd Department of Surgery of St. Anne's University Hospital Brno has been dealing with surgical treatment of TOS since 1982. Between 1982 and 2006, i.e. within 24 years, 141

patients were operated on. Out of a group of 100 patients in whom simple first rib resection was performed, re-operation after 2 years was necessary in 3 patients because of the same problems as before the operation (3 % of the patients). In these patients, symptoms occurred in 3–12 months after the first operation. They were caused by new fibrous bands that developed in the surgical wound after the rib removal, probably as a result of a residuum of periosteum. Other types of operations were as follows:

– First rib resection with upper thoracic sympathectomy was performed 20 times.

– First rib resection with arterial reconstruction (thrombectomy, prosthesis) was performed 11 times.

– Resection of the cervical rib and the first rib and fibrous bands 1 time.

– Resection of the cervical rib and fibrous bands 3 times.

– Resection of the pectoralis minor muscle insertion 6 times.

There was no case of death during the surgical treatment. Five years later, in 55 % of the operated patients, significant improvement was observed (elimination of symptoms); 20 % of patients have moderate complaints (cervical spine pain, cervicocranial syndrome, omarthrosis). 2.2 % of the operated patients reported considerable complaints (identical to those before operation). Skin neuralgia in the surgical wound (in 0.7 % of patients) can be treated with injections of local anaesthetics. 19.1 % did not come to the follow-up examination.

Discussion

Only a few workplaces in the Czech Republic deal with the TOS. The incidence of this condition is relatively low. According to the Register of Vascular Operations, about 20–30 patients are operated on for TOS every year. Initially, the treatment should always be conservative (rehabilitation), unless there is an acute vascular event. In case that rehabilitation treatment failed and the cause of TOS was proved, surgical treatment is recommended.

Treatment of TOS is multidisciplinary. An angiologist, neurologist, radiologist, physiotherapist and vascular surgeon participate in diagnostics and comprehensive treatment. Surgical treatment should be performed by the most experienced surgeons. In vascular complications of TOS, interventional radiologic procedures and thrombolysis have been successfully applied in recent years. Since the success rate of disappearance of all symptoms is not that satisfying, these problems deserve continuous attention. These problems are experienced mostly by younger population groups, predominantly by women. Timely diagnosis and treatment can prevent severe damage to vascular and nervous structures of upper limbs.

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