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Operative technique for thoracoscopic thymectomy

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Abstract. In most cases, myasthenia gravis (MG) and thymoma require complete removal of the thymus gland and resection of the pericardial fatty tissue. There is some debate however, over which surgical approach is best for thymectomy. We have developed a new technique for complete thoracoscopic thymectomy. Between October 1994 and February 1998, we performed a prospective observational study of thoracoscopic thymectomy in 19 patients. The results were analyzed with special reference to perioperative morbidity, short- and intermediate-term improvement of MG, and quality of life. This study showed the feasibility of complete thoracoscopic thymectomy. The procedure was successfully applied in 19 of 20 cases. Thoracoscopic thymectomy was accomplished with zero mortality and a very low perioperative morbidity. While the short-term improvement of MG after this procedure was comparable to that seen with conventional surgery, the short- and intermediate-term quality of life was much better. The preliminary results of thoracoscopic thymectomy appear to be excellent for both patients and neurologists. A prospective randomized trial has been designed to compare thoracoscopic thymectomy with the gold standard of median sternotomy for thymectomy.

Key words: Thoracoscopic thymectomy — Technique — Myasthenia gravis — Thymoma — Thymus

The central role of thymectomy in the complex multimodal treatment of myasthenia gravis (MG) is accepted worldwide [2, 3, 5, 6, 12, 13, 18, 24]. Consensus favors thymectomy in myasthenic patients because it is assumed that autoimmune tolerance is reestablished after thymectomy [3, 7, 12]. Patients with a suspected thymoma are also treated with thymectomy [6, 20].

The first thymectomy for MG was performed by Sauerbruch in 1911 [22]. In 1944, Blalock published the first series of patients treated by the transsternal approach [2]. In the biggest series of thymectomies at that time, the refined technique of median sternotomy, was employed with great success by Keynes [8]. Despite initial enthusiasm, a long controversy about the role of thymectomy in MG ensued. Ultimately, thymectomy was accepted as a major part of the treatment of MG. Today, thymectomy is recommended for treating stages I–III of MG [4, 6, 7, 12, 13, 18]. Complete removal of the thymus gland, including the surrounding mediastinal tissue is required, and the procedure must be accomplished with minimal trauma.

There is an ongoing debate about the most suitable surgical approach for thymectomy as illustrated by the wide variety of different techniques that have been described in the literature [5, 7–10, 12, 13, 20, 21, 24, 25]. Thoracoscopic thymectomy has recently been introduced, and the optimization of this new technique is presently a matter of clinical research [10, 14, 15, 20, 21, 25]. This new procedure aims at minimal invasiveness [10, 20, 21, 25].

Materials and methods

Thoracoscopic thymectomy was studied prospectively with special reference to feasibility, technical aspects, results, and procedure-related complications of the new method. The main concern was to optimize the technique of thoracoscopic thymectomy.

Preoperative assessment and criteria for patient selection

All patients who met the following inclusion criteria for the thoracoscopic approach were included in the study: diagnosis of MG of stages I–IIb (Ossermann classification) without thymoma or with encapsulated thymoma <2 cm in diameter. Informed consent was obtained from all patients. The diagnostic procedures included chest radiograph, thoracic computed tomography, assessment of pulmonary function, and complete neurologic workup (serological testing, clinical staging according to the modified Besinger score, Tensilon test, electromyography, exclusion of paraneoplastic myasthenia) to establish the stage of MG according to Ossermann. The

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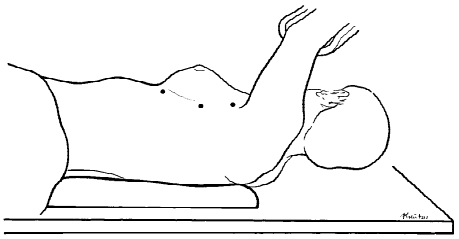

Fig. 1. Trocar positions along the left submammarian line with the patient in the 30° right lateral decubitus position for thoracoscopic thymectomy.

indication for thymectomy was jointly established by a neurologist and a surgeon.

Operation

The standardized technique is performed from the left with the patient in the 30° right lateral decubitus position under single right-lung ventilation. Alternatively, with prevailing enlargement of the thymic gland to the right side on preoperative CT scan, a right-sided approach is chosen. Three trocars are placed between the third and fifth intercostal space of the anterior chest wall approximately following the submammarian line (Fig. 1).

After general exploration, the left mediastinal pleura is incised. The dissection is then extended caudally along the capsule of the thymus gland. Continuous gentle traction on the thymus provides progressive exposure of the lower poles, which are usually distinguishable from the mediastinal fat (Fig. 2). Lateral dissection includes pericardial tissue and preserves the phrenic nerve. Blunt preparation continues to the level of the innominate vein. There are two to three thymic veins to be exposed at their junction with the innominate vein (Fig. 3). The presence of an aberrant thymic lobe, occasionally found posterior to the innominate vein, does not necessitate conversion to a sternum-splitting operation. The resected gland is brought into an Endo-Bag and can thus be removed through one of the trocar incisions (Fig. 4).

Follow-up and postoperative management

During the follow-up period, the patients were periodically assessed with respect to clinical improvement according to the modified Viets/Schwab criteria (A, complete remission without medication; B, clinical improvement with reduction of medication by >50%; C, unchanged stage, D, deteriorated clinical stage; E, MG-related death) [23]. Operation time, duration of hospital stay, morbidity, mortality, and quality of life were analyzed.

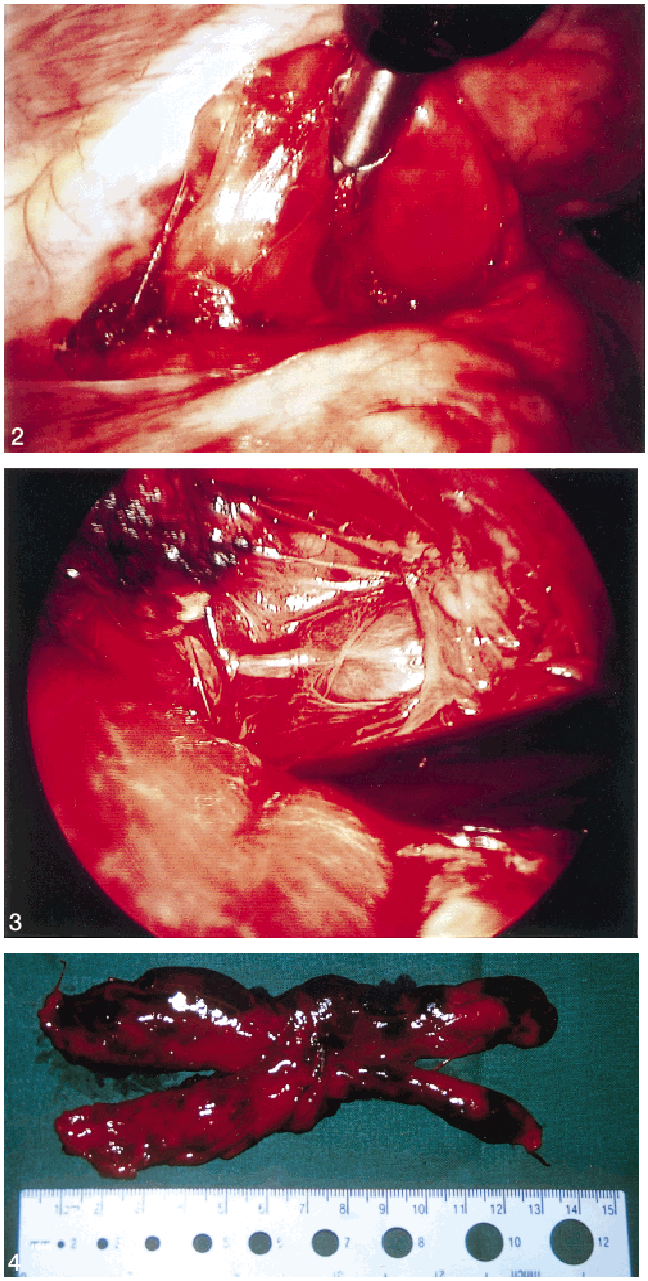

Fig. 2. Preparation of the left lower part of the thymus gland. The thymic poles are usually distinguishable from the mediastinal fatty tissue.

Fig. 3. Exposure of the entry of a Keynes vein into the innominate vein after clip ligature.

Fig. 4. Resected specimen comprising the whole hyperplastic thymus gland after removal through one of the trocar incisions.

Results

Twenty patients (15 female, five male; mean age, 38.4 years; standard deviation (SD), 12.8) were selected for thoracoscopic thymectomy in our initial prospective observational study between October 1994 and February 1998. Clinical data for these patients are shown in Table 1.

In 19 of the 20 cases, thymectomy was carried out completely by thoracoscopy. In one patient with MG and thymoma, conversion to median sternotomy was necessary for technical reasons. Neither an extension of access by small utility thoracotomy nor an additional transcervical approach was indicated in any of these cases.

The mean operation time was 122 min (SD, 39). The postoperative amount of pain medication necessary was very small in all 19 patients with complete thoracoscopy. The preoperative clinical condition of the patients, as measured by their subjective evaluation, and the degree of mobilization were restored on the 2nd postoperative day. A longer recovery was observed only after conversion to median sternotomy and rethoracoscopy in one case each. The intraoperative blood loss in each case operated on thoracoscopically was far <100 ml. There was no perioperative mortality in our patient group.

Leakage of blood into the pleural dome required rethoracoscopy in one patient on the 1st postoperative day. The same female patient developed a chylothorax on the 3rd postoperative day, necessitating a further operative revision

Table 1. Clinical data

Patient no.	Sex/age (yr)	Indication	Ossermann classification	Histomorphology
1	m/37	MG/ thymoma	IIa	cortical thymoma (25 mm)[a]
2	f/52	MG	IIb	thymic persistence
3[b]	m/42	MG/ thymoma	IIa	epitheloid thymoma (25 mm)[a]
4	f/36	thymoma		epitheloid thymoma (45 mm)[a]
5	f/58	MG	I	thymic persistence
6[c]	f/23	MG	IIb	follicular hyperplasia
7	f/52	MG	IIb	thymic persistence
8	f/23	MG	IIa	follicular hyperplasia
9	f/35	MG	IIa	follicular hyperplasia
10	f/29	MG	IIa	follicular hyperplasia
11	f/53	MG	IIb	thymic persistence
12	m/24	MG	IIa	follicular hyperplasia
13	f/28	MG	IIa	follicular hyperplasia
14	f/20	MG	IIb	follicular hyperplasia
15	m/36	MG	IIb	follicular hyperplasia
16	f/26	MG	IIa	follicular hyperplasia
17	m/61	MG	IIa	thymic persistence
18	f/38	MG	IIa	follicular hyperplasia
19	f/40	MG	IIb	follicular hyperplasia
20	f/54	MG	I	follicular hyperplasia

m, male; f, female; MG, Myasthenia gravis
[a] maximal diameter of thymoma
[b] conversion to median sternotomy
[c] right-sided approach

Table 2. Functional improvement of myasthenia gravis according to the Viets/Schwab classification

Patient no.	Postoperative follow-up (mo)	Stage (Viets/Schwab)
1	39	C
2	38	C
5	33	B
6	29	B
7	28	C
8	27	C
9	25	B
10	21	B
11	21	C
12	19	A
13	16	C
14	11	C
15	10	B
16	8	B
17	6	C
18	4	B
19	1	C
20	1	C

for sealing of the leakage. There were no further postoperative complications. In the 18 uncomplicated thoracoscopic thymectomies, the suction drain was removed on the 1st postoperative day. Postoperative morbidity was low; two small pleural effusions were observed but without indication for puncture. The mean duration of the hospital stay in the surgical clinic was 4 days (SD, 3).

In the prospective series reported here, the total duration of hospitalization was prolonged by the neurological workup. Histological examination confirmed complete thymic extirpation in all cases of thoracoscopic thymectomy, with removal of various amounts of pericardial fatty tissue. The most frequent finding was thymic hyperplasia, which was diagnosed in 12 cases (Table 1). All specimens, including the thymomas, were benign; no histological invasion was noted.

For assessment of improvement rates of MG after thymectomy, so far only short- and intermediate-term results are available. With a mean follow-up of 18.7 months (SD, 12.3), the results measured according to the Viets/Schwab classification are detailed in Table 2. Functional improvement was observed in all 18 patients.

Discussion

Thymectomy is an accepted therapeutic option for treating myasthenia gravis (MG) and thymoma [2, 3, 5, 6, 12, 13, 16, 18, 25]. There are various conventional approaches for thymectomy with different degrees of invasiveness, reflecting the ongoing controversy over the best surgical approach for thymectomy in myasthenic patients [5, 7–10, 12, 13, 16, 20, 24, 25]. At our clinic, the preferred conventional approach was formerly midline sternotomy or anterolateral thoracotomy; these techniques were employed for 130 thymectomies performed before 1983 [24]. Since then, another 119 conventional thymectomies for MG, with a mean follow-up of 84 months, have been carried out at this institution. The improvement rates achieved for MG in this series are among the best reported in the literature [7, 12, 13, 24, 25]. As a result of advanced surgical experience, thoracoscopic thymectomy has been developed as a complete new procedure [20]. Of course, this development was also influenced by new technologies and patient wishes. This new approach aims at the least possible degree of invasiveness. By contrast Jaretzki has argued for maximal radicality by combining sternotomy with cervical access [7].

Operation time for the different approaches varies. A thoracoscopic thymectomy performed at our clinic presently takes ~2 h. With thoracoscopy, pain during the immediate postoperative period is considerably less than that experienced after anterolateral thoracotomy or median sternotomy.

In addition, the patients, who tend to be relatively young, appreciate the cosmetic result after thoracoscopic thymectomy. The near absence of scar formation is a convincing benefit to patients and neurologists alike. The decision to opt for thymectomy in cases of myasthenia gravis is made by the neurologist, who naturally wants the most sparing treatment for the patient. Therefore, neurologists tend to demand thoracoscopic thymectomy at an earlier stage of MG, when results are even better. Furthermore, as compared to the conventinoal approaches, perioperative morbidity is very low after thoracoscopic thymectomy [10, 14, 17, 20, 21].

With the exception of one patient who required rethoracoscopy, we did not notice any negative effects of a learning curve. At the same time, this same patient demonstrated the possibility of successful thoracoscopic revision.

The short-term results in our patient population show the same functional improvement rates after thoracoscopic surgery as those that have been reported in the literature; they are comparable to the improvement rates of our series of conventional thymectomies [20]. This is a *conditio sine qua non* and thus the most important prerequisite for continuing the clinical investigation of thoracoscopic thymectomy.

There are very few data available on thoracoscopic thymectomy. Most surgeons perform a left-sided thoracoscopy [10, 11, 14, 15]. The conversion rate is similar in all series [10, 25].

There are other advantages of the new procedure, too. If the relatively young patients who undergo thymectomy thoracoscopically require cardiac surgery during their later years, a redo sternotomy will not be necessary, as it will in patients who undergo transsternal thymectomy. In particular, the mammary artery is saved by the thoracoscopic approach, while it is ligated with partial median sternotomy for thymectomy [9].

Recently, Busch et al. published an interesting analysis of the long-term outcome and quality of life after thymectomy for MG [4]. If it is indeed difficult to show that thymemectomy yields significant benefits in the treatment of MG of Osserman stages I–IIb, we must assume that minimally invasive thoracoscopy is the most appropriate approach, especially in view of the fact that it hardly affects the quality of life.

Although there is a general consensus that complete thymectomy should be performed, there is no agreement on the exact meaning of "complete" [5, 7–10]. There are two situations in which thymectomy is unsuccessful: where there is ectopic thymic tissue left and where there is an incomplete thymus gland removal [1]. Although the very demanding technique of transcervical thymectomy can be performed by experienced surgeons with excellent results, transcervical access may be somewhat problematical in this respect [5, 19]. But the anterior mediastinal area, however, can be perfectly visualized through either the left or right pleural cavities [10, 14, 20, 25]. Recent reports indicate that anatomical considerations have led one of the most experienced teams to focus on the right-sided thoracoscopic approach for thymectomy [10, 11, 15]. Adjuvant pneumomediastinum to facilitate the dissection maneuvers and to shorten operative time, as proposed by Mineo et al., however, increases invasiveness and should therefore be used in selective cases only [14].

In conclusion, thoracoscopic thymectomy compares favorably with the conventional approaches in terms of mediastinal view, exposure of the thymus gland, radicality, thoracic destablization, pulmonary function, postoperative pain, and cosmetic results. Thoracoscopic thymectomy may result in earlier thymectomy in the complex therapeutic setting of MG and become the method of choice for selected patients. These promising initial results now justify a longitudinal comparison of the thoracoscopic approach with median sternotomy for thymectomy.

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