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ORIGINAL ARTICLE

Comparative clinical outcomes after thymectomy for myasthenia gravis: Thoracoscopic versus trans-sternal approach

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Summary *Background:* Thymectomy is an effective treatment option for long-term remission of myasthenia gravis. The superiority of the trans-sternal and thoracoscopic surgical approaches is still being debated. The aims of this study are to compare postoperative outcomes and neurologic outcomes between the two approaches and to identify prognostic factors for complete stable remission (CSR).
Methods: Myasthenia gravis patients who underwent thymectomy with trans-sternal or thoracoscopic approach in MahaRaj Nakorn Chiang Mai Hospital, Chiang Mai, Thailand between January1, 2006 and December 31, 2013 were retrospectively reviewed. The endpoints were postoperative outcomes and cumulative incidence function for CSR. The analysis was performed using multilevel model, Cox's proportional hazard model, and propensity score.
Results: Ninety-eight patients were enrolled in this study: 53 in the thoracoscopic group and 45 in the trans-sternal group. There were no significant differences between groups in composite postoperative complications, surgical time, ventilator support days, and length of intensive care unit stay. Intraoperative blood loss and length of hospital stay were significant less in

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the thoracoscopic group. The CSR and median time to remission were not significantly different between the two approaches. Prognostic factors for CSR were nonthymoma (hazard ratio: 3.5, 95% confidence interval: 1.01—12.22) and presence of pharmacological remission (hazard ratio: 24.3, 95% confidence interval: 3.27—180.41).
Conclusion: Thoracoscopic thymectomy is safe and provides good neurologic outcomes in comparison to the trans-sternal approach. Two predictive factors should be considered for CSR. Further prospective studies with a larger sample size and longer follow-up period are warranted to confirm these results.

1. Introduction

Myasthenia Gravis (MG) is an auto-immune disease associated with abnormal antibodies binding to the acetylcholine receptors at the neuromuscular junction of the skeletal muscle and causing the destruction and modification of the neuromuscular junction.[1] MG patients usually present with a fluctuating degree of weakness of the skeletal muscle, e.g., ocular, bulbar, respiratory muscles, and extremities.[2]

MG is strongly associated with thymic abnormalities. About 10—21% of myasthenia patients have thymoma and 65—70% of those have thymic hyperplasia,[3,4] whereas 20—47% of patients with a thymoma have MG.[5—7] Previous studies reported that 40—90% of MG patients achieved remission after thymetomy versus 10—20% of those on medication alone.[8,9] Thymectomy can be completed according to several approaches: trans-sternal, transcervical, thoracoscopic, and subxyphoid. Trans-sternal thymectomy has been the treatment of choice for MG patients according to the Myasthenia Gravis Foundation of America (MGFA). Recently, the thoracoscopic approach is not only widely performed in early stage nonsmall cell lung cancer,[10—13] but also in thymectomy because of less pain, smaller scarring, shorter length of hospital stay, and lower incidence of myasthenia crisis in comparison to the trans-sternal approach.[14] Moreover, the rate of complete stable remission (CSR) is not inferior to what is obtained with the trans-sternal approach.[15—18]

In our institute, thoracoscopic thymectomy has been performed since 2006. There are no reports on the comparative effectiveness between the two approaches in Thailand. Therefore, this study was conducted to compare postoperative outcomes and long-term neurologic outcomes between thoracoscopic and trans-sternal approaches.

2. Methods

This study is a retrospective cohort study of MG patients who underwent trans-sternal or thoracoscopic thymectomy between January 1, 2006 and December 31, 2013 at Maharaj Nakorn Chiang Mai Hospital, Chiang Mai University, Chiang Mai, Thailand. All patients were diagnosed by neurologists using the MGFA clinical classification.[19] Contrasted computed tomography (CT) scan was performed in all cases. Thymoma or malignant thymoma were diagnosed and evaluated by expert thoracic radiologists from our institute, using published criteria based on a CT scan. The tumor can be identified as invasive by imaging that show invasion of the surrounding tissue or great vessels.[20] Preoperative blood antiacetylcholine receptor antibody titers were not performed. The primary endpoint of this secondary analysis was postoperative outcomes [operative time, blood loss, composite postoperative complications, length of intensive care unit (ICU) and hospital stay, intubation time, 28-day mortality]. The composite postoperative complications include all postoperative complications (diaphragmatic paralysis due to phrenic nerve injury, atelectasis, cholinergic crisis, myasthenic crisis, reintubation, and pneumonia). The secondary endpoint was CSR defined as no signs or symptoms of MG and no therapy for at least 1 year after surgery, except for isolated weakness of eyelid closure.[19] This study was reviewed and approved by the Research Ethics Committee, Faculty of Medicine, Chiang Mai University.

2.1. Surgical techniques

In our institute, selection criteria for thoracoscopic approach for MG are one of following: (1) nonthymomatous patients; or (2) small ($<$ 3 cm) intrathymic thymoma.[21,22] Trans-sternal thymectomy was performed with the standard technique. Thoracoscopic approach was performed through the right side with three small incisions under general anesthesia with isolated lung ventilation. The patient was placed in the left lateral decubitus position and slightly supine, about 30°. Right arm was abducted about 120° and the elbow was flexed over a padded L-screen for exposure. A camera port was placed at the eight intercostal space midaxillary line, and two working ports were placed at the fourth intercostal space at the anterior axillary line and sixth intercostal space at the posterior axillary line. Prepericardial fat above the right phrenic nerve was dissected. Thymic tissue and all anterior mediastinal fat were also dissected away 1 cm anterior to the left phrenic nerve. Arterial supplies and venous drainage were ligated with metallic clips. Bilateral superior horns were dissected with blunt technique. Thymus tissue and prepericardial fat pad on left side were removed as much as possible or at least reaching to left pleura. A right chest drain was placed in the right pleural space. Extubation was performed immediately after operation, in the recovery room or in the intensive care unit depending on the consideration of the anesthesiologists.

In cases of left side tumor, especially if $>$ 3 cm, we performed a trans-sternal approach. If the tumor was well

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