

Trans-Cervical Thymectomy Under Local/Regional Anaesthesia in Treatment of Myasthenia Gravis

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Abstract

Background: Myasthenia Gravis (MG) is an auto-immune neuro-muscular disorder characterized by muscular fatigability and weakness of voluntary muscles. Thymectomy is the preferred method of treatment. Trans-sternal route is the standard approach to thymectomy, however, it necessitates general anaesthesia which is a challenge in MG and sternotomy further restrict the ventilatory function of myasthenics post-operatively.

Purpose: Is to reveal the feasibility and safety of trans-cervical thymectomy (TCT) under local (cervical block) anaesthesia with stepwise description of its technique.

Patients and Methods: 15 patients with non-thymomatous MG (7 M & 3 F) with a mean age of 44.8 y (30-60 y) were included from 2010-2011 and the eligibility criteria were; patients with non-thymomatous mild to moderate MG (Class 1-3 according to a modified Osserman classification) who are motivated to undergo TCT under local anaesthesia. Exclusion criteria were; thymomatous MG, class 4 MG with severe fulminant disease, unduly anxious or uncooperative patient, communication difficulty (language barrier or hearing deficit), associated endemic goiter or autoimmune thyroid disease, concomitant cervical lymphadenopathy, previous neck irradiation, previous neck surgery or sternotomy. All patients underwent bilateral superficial cervical block anaesthesia using 50:50 mixture of 0.5% lidocaine and 0.25% bupivacaine and TCT is done in the standard way apart from adding the step of intracapsular (intrathymic) injection of the local anaesthetic. Post-operative chest X-ray was done for all patients to detect pneumothorax or phrenic nerve injury. Post-operative pain was assessed by visual analogue scale (Range, 0-10 ; 0 = No pain, 10 = Maximal pain).

Results: All 15 procedures were successfully performed under loco-regional anaesthesia in a mean time of 59.5 minutes (50-90m, SD±7.97) with no conversion to general anaesthesia or trans-sternotomy approach.

Intra-operative discomfort was minimal and well tolerated. Intra-operative pleural leak was not observed in any of our patients with no post-operative pneumothorax. None of the

patients complained of intra-operative or post-operative dyspnea and neither post-operative ventilation nor admission to intensive care unit was needed. No recurrent laryngeal nerve injury occurred and in only one case transient unilateral phrenic nerve palsy happened. No hypoparathyroidism occurred. A mean post-operative drainage of 53cc (30-100cc, SD±24.2) blood was obtained with no chylous leak in any of the cases. Only one case developed post-operative subcutaneous haematoma which was managed conservatively. Post-operative pain was well tolerated by all with a mean visual analogue scale of 0.4±0.1. All patients were satisfied of the procedure and the mean hospital stay was 39.3 hours (24-48h, SD±8.28). Gross assessment of the extracted specimen revealed complete glandular lobar resection in all cases with a final histopathology of thymic hyperplasia.

Conclusion: TCT under local (superficial cervical block anaesthesia) is feasible and safe, An addition that seems to potentially deserve consideration in the management of MG.

Key Words: *Thymus – Myasthenia gravis – Thymectomy – Cervical block.*

Introduction

MYASTHENIA Gravis (MG) is a neuro-muscular disorder with an auto-immune pathogenesis causing dysfunction of the post-synaptic acetyl choline receptors with depression of neuro-muscular transmission leading to the clinical symptoms of sporadic muscular fatigability and weakness of voluntary muscles [1,2]. Thymectomy is preferred as the standard method in treatment of MG by most investigators who consider it as the most effective treatment for achieving sustained improvement in such patients [1-5]. Trans-sternal route is the standard approach to thymectomy [6], however, it necessitates general anaesthesia and sternotomy further restrict the ventilatory function of myasthenics post-operatively [7]. Trans-cervical approach to thymectomy has been introduced in treatment of MG by Crile in 1966 [8] as did Kirschner sooner [9] and then revived by Cooper in 1988 [10]. Trans-

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cervical thymectomy (TCT) has been demonstrated to have comparable results to Trans-sternal thymectomy in treatment of MG [11]. Numerous authors prefer TCT because it is less invasive, reduces complications and costs with better post-operative recovery and shorter hospital stay [10,12,13]. However, still like trans-sternal thymectomy it is done under general anaesthesia which is considered a challenge to the anaesthesiologist in patients with MG, because muscle relaxants (both depolarizing and non-depolarizing) and inhalational anesthetics, all affect the neuro-muscular transmission with the higher sensitivity of myasthenic patients to such blockade and so the predicted prolonged post-operative recovery and the need for post-operative ventilation and intensive care [14]. Thymus gland is a cervico-mediastinal structure which is embryologically related to the thyroid and parathyroid glands, it starts in the lower part of the neck as the thymic horns that are attached to the lower poles of the thyroid lobes by thyro-thymic ligaments and extends into the superior mediastinum till the level of the 4th intercostal space. In the neck it lies on the trachea behind the pretracheal fascia and in the superior mediastinum it lies between parietal pleura and extra-pleural fat. It is enclosed in a fibrous capsule that separates it from the surrounding structures [6,15,16]. Thymus gland is innervated by sympathetic and parasympathetic (vagus) innervations that enter the gland via its blood vessels [6,15]. Visceral afferents run with sympathetic and parasympathetic (vagus) nerves that carry nociceptive stimuli to the central nervous system. Vagal visceral afferents carry visceral sensations not only from neck viscera but also from tracheal fascia and surgical capsules [17]. In recent reports local and/or regional anaesthesia (cervical block) was shown to be valid and safe alternative to general anaesthesia for most patients undergoing thyroidectomy and parathyroidectomy [18-21]. As far as we know there were no reports of performing TCT under local anaesthesia, so it seemed scientifically justifiable on basis of the previous data to intuitively anticipate that TCT could be performed under local/regional (cervical block) anaesthesia as is in case of thyroidectomy and parathyroidectomy. In this study we aimed at revealing the possibility of performing TCT under local (cervical block) anaesthesia with stepwise description of its technique.

Patients and Methods

Patients characteristics and selection

Fifteen patients with non-thymomatous MG (7 males & 3 females) with a mean age of 44.8 years (30-60 years) were referred by neurologists to our endocrine surgery unit from 2010-2011 in the

national institute of endocrine diseases as being indicated for surgery were included and an informed consent was taken after full discussion of the procedure to every patient. The study proposal was approved by the ethics committee of the general organization of teaching institutes and hospitals and the eligibility criteria were; patients with non-thymomatous mild to moderate MG (Class 1-3 according to a modified Osserman classification (10): 0=Asymptomatic; 1=Ocular signs and symptoms only; 2=Mild generalized weakness; 3=Moderate generalized weakness; and 4=Severe generalized weakness, respiratory dysfunction, or both. Who are motivated to undergo TCT under local anaesthesia. Exclusion criteria were; thymomatous MG, class 4 MG with severe fulminant disease, unduly anxious or uncooperative patient, communication difficulty (language barrier or hearing deficit), associated endemic goiter or autoimmune thyroid disease, concomitant cervical lymphadenopathy, previous neck irradiation, previous neck surgery or sternotomy and allergy to local anaesthesia.

Procedural technique

Local anaesthesia:

As a premedication patients received oral diazepam at bed time and in the morning before operation. Once the patient was on the operating table and after monitoring of vital signs (ECG, non-invasive blood pressure, pulse oximetry) was setup, intravenous sedation was obtained with midazolam 3mgs and fentanyl 50mcg. Additional fentanyl increments of 25mcg were given as needed. A local anaesthetic in the form of 50:50 mixture of 0.5% lidocaine and 0.25% bupivacaine was used.

Bilateral superficial cervical block was done by injecting 10ml of the local anaesthetic on each side using 4cm, 23 gauge needle inserted at Erb's point (Mid-point along the posterior border of the sterno-cleido-mastoid muscle) infiltrating subcutaneously superficial to the investing layer of deep cervical fascia within 1cm above and below this point. The needle was then redirected superiorly along the anterior border of sterno-cleido-mastoid muscle to infiltrate the cervical branch of facial nerve with additional 5ml to desensitize platysma muscle, the needle is then relocated medially towards mid-line deep to the investing layer of deep cervical fascia instilling another 5ml of local anaesthetic to desensitize strap muscles and obtund neck visceral sensation. Finally 5ml of local anaesthetic was administered subcutaneously along the proposed line of cervicotomy incision and additional doses were administered by the surgeon after operative exposure especially intracapsular

at the apex of the thymus gland as will be described in the operative steps. Also additional boluses of midazolam were administered during the operation when extracting the thymus gland to relieve anxiety from discomfort felt on traction on neck viscera. Supplemental oxygen 3 l/m was administered via a nasal canula. During the entire procedure the patient was awake and able to speak with the surgical team. Approximately 40 to 60ml of local anaesthetic was instilled throughout the entire procedure.

Surgical procedure:

The patient is put in supine position with arms at the sides and a pillow below the nape of the neck, the table is then adjusted to the reverse trendelenberg's position (this position helps to reduce bleeding especially of venous origin). A short, 4cm Kocher incision is done at the lower skin crease 2cm above the jugulum, cutting through the cuticle, subcutaneous tissues and platysma muscle. Subplatysmal flaps are then fashioned cranial till the thyroid cartilage and caudad to the suprasternal notch. The strap muscles are split and separated in the midline longitudinally along the linea alba colli, (the jugular venous arch between the two anterior jugular veins if met it should be secured with clamps, divided and ligated) to expose the pretracheal fascia; an important anatomical landmark extending down to the fibrous pericardium in front of the thymus gland. retraction of strap muscles permits entering into the pretracheal space and mediastinum, firstly we identify the lower poles of the thyroid gland, then the two cervical portions of the thymus gland (thymic horns) are readily identifiable; the thymic tissue is light brown in colour and denser than the cervical mediastinal fat, also fibrous strands with sometimes blood vessels may be seen extending between the lower poles of the thyroid and the thymic horns (thyro-thymic ligaments). Care should be exercised to identify the inferior parathyroid glands that may lie on the thymic horns or along the thyro-thymic ligaments, if found they should be safeguarded with their vascular pedicles. At this step the author's exercise was to grasp the cervical portion of the thymus gland and perform intracapsular injection of xylocain 2% to obtund visceral afferent sensations from manipulating the gland. This also will inflate the gland that is encased within a fibrous sheath, helping in its delineation from the surrounding cervical mediastinal fat and making it more tougher and denser, thus further facilitating its dissection and easy complete stripping. Gentle traction is applied to the exposed presenting portion of the thymus via a grasping tender grip forceps,

with anterior traction on the manubrium sterni, careful blunt dissection with "a pea nut" gauze clamp is performed keeping dissection close to the gland to avoid injury of major vessels and avoid dissection laterally so as not to tear mediastinal pleura, the thymus gland is rather tough tissue which is enclosed in only a thin fascia, and by maintaining traction together with blunt and sharp dissection it is easily separated from adjacent structures and as blunt dissection proceeds the line of cleavage is maintained close to the gland. Typically the left superior pole is identified first and dissected free towards the point at which it merges with the right superior pole which is similarly dissected free. The superior poles meet just above or below the sternal notch and together pass into the mediastinum anterior to the innominate vein. With the superior poles fully freed down to the level of the innominate vein, dissection proceeds along the posterior aspect of the gland with search for medium sized veins (thymic veins) which are ligated and divided. Then continuing upward traction on both lobes (held together) with blunt dissection the thymus gland which remains completely encapsulated became stripped out and separated without difficulty from the pericardium. Using larger sponge dissection clamp and with the aid of adequate sternal retraction it is quite easy to depress the great vessels and allow direct visualization into the aorto-pulmonary window for complete removal of the thymic tissue in this vicinity. Care should be taken to avoid injuring the phrenic and recurrent laryngeal nerves which is particularly and advantageously applicable in this technique of conscious anaesthesia through verbal communication with the patient that monitors the recurrent laryngeal nerve and the diaphragmatic motion that occurs as electrocautery nears the phrenic nerves. In most cases the thymus gland is removed in the form of a complete gland with both upper and lower poles intact. Careful inspection of the remaining tissues in the mediastinum is performed to identify any possible retained thymic tissue and bits of fat in the antero-superior mediastinum are removed.

Finally searching for any ectopic cervical thymic tissue in the retrothyroid areas and around the carotid sheaths is performed to remove it. The operative field is carefully inspected for any bleeding site or mediastinal pleural tear. The wound is closed in layers after leaving suction drain. All patients were continued on their preoperative pharmacologic therapy of myasthenia gravis and post-operative chest X-ray was done for all patients to detect pneumothorax or phrenic nerve injury. Post-operative pain was assessed by visual analogue scale (Range, 0-10; 0=No pain, 10=Maximal pain).

Results

All 15 procedures were successfully performed under loco-regional (bilateral superficial cervical block) anaesthesia in a mean time of 59.5 minutes (50-90m, $SD \pm 7.97$) with no conversion to general anaesthesia or trans-sternotomy approach.

Intra-operative discomfort during traction on the thymus was minimal and well tolerated and none of the patients complained of intra-operative dyspnea. Intra-operative pleural leak was not observed in any of our patients with no post-operative pneumothorax on post-operative chest X-ray done for all of them. None of the patients complained of post-operative dyspnea and neither post-operative ventilation nor admission to intensive care unit was needed. No nerve injury occurred either in recurrent laryngeal nerve or phrenic nerve, only unilateral transient phrenic nerve palsy occurred (known by the raised one cupola of the diaphragm on post-operative chest X-ray) which resolved spontaneously. No hypoparathyroidism occurred. A mean post-operative drainage of 53cc (30-100cc, $SD \pm 24.2$) blood was obtained with no chylous leak in any of the cases. Only one case developed post-operative subcutaneous haematoma which was managed conservatively and resolved spontaneously within few days. Post-operative pain was well tolerated by all of the patients with a mean visual analogue scale of 0.4 ± 0.1 . All of our patients were satisfied of the procedure and the mean hospital stay was 39.3 hours (24-48h, $SD \pm 8.28$). Gross assessment of the extracted specimen revealed complete glandular lobar resection (known by the integrity of the capsule with intact superior and inferior poles) in all cases with a final histopathology of thymic hyperplasia (Table 1 and Fig. 1).

Table (1): Assessment of the procedure outcome .

Mortality	Nil
Operative time (minutes)	Mean = 59.5 \pm 7.97 (50-90)
Hospital stay (Hours)	Mean = 39.3 \pm 8.28 (24-48)
<i>Nerve injury:</i>	
Phrenic n.	Nil (1 transient palsy)
RLN	Nil
Hypoparathyroidism	Nil
Intraop. Pleural tear	Nil
Postop. pneumothorax	Nil
Chylous leak	Nil
Discomfort on thymic traction	Well tolerated
Dyspnea (Intra op. or post op.)	Nil
Post-op. drainage (ml)	Mean = 53 \pm 24.2 (30-100)
Post-op. haematoma	1
Conversion to GA	Nil
Conversion to sternotomy	Nil
Post-op. pain	Well tolerated
Completeness of resection	Mean VAS = 0.4 \pm 0.1
Final histo-pathology	All complete
Post-op. ventilation and/or icu admission	Lymphoid hyperplasia
	Nil



Fig. (1): Complete glandular, bipolar resection with intact upper & lower poles.

Discussion

The challenging situation of general anaesthesia in myasthenia gravis patients [14] together with the comparable outcome of trans-cervical thymectomy and trans-sternal thymectomy in treatment of such patients [11,22] and the long known success of thyroidectomy and parathyroidectomy under local/regional anaesthesia [18-21] with the anatomical fact of that the cervical portions of the thymus gland being located within the same anatomical confines of the thyroid and parathyroid glands, were the bases that inspired us to anticipate similar success in performing TCT under local/regional anaesthesia (superficial cervical block). In superficial cervical block anaesthesia, the local anaesthetic is injected in the subcutaneous tissue above the investing layer of deep cervical fascia at the Erb's point (Midpoint of the posterior border of sterno-mastoid muscle), this will only anaesthetize the cutaneous branches of the cervical plexus carrying sensations from front and lateral neck, and there will be no desensitization of the platysma muscle and strap muscles or neck viscera. So we used the modification of Yerzingatsiak [17], by relocating the needle upward along the anterior border of sterno-mastoid muscle to infiltrate the cervical branch of facial nerve to desensitize the platysma muscle, and also redirecting the needle medially towards the mid-line deep to the investing layer of the deep cervical fascia to anaesthetize the ansa hypoglossii to desensitize strap muscles and obtund the visceral sensory afferents from neck viscera (running along its blood vessels) and tracheal fascia [17]. During abdominal surgery under local or regional anaesthesia, viscera can be grasped or cut without the patient being aware, however, patient starts to feel discomfort or uneasiness of traction if traction is applied to the peritoneum [23], the same applies to any neck viscera like the

thyroid and thymus glands on applying traction on it. The technique of TCT depends mainly on traction on the thymus gland which was associated with discomfort due to traction on tracheal fascia, pericardium, and may be mediastinal pleura. Such traction discomfort may be tolerated by some patients but others may not tolerate it and become anxious [24], our policy was to perform intracapsular injection of the local anaesthetic at the apex of each lobe of the thymus gland, this not only helps to obtund visceral afferent sensation from the gland but also to inflate the gland making it more denser and tougher than the surrounding tissues with more obvious plane of cleavage with the surroundings, facilitating its easy complete stripping of the surrounding tissues without being broken through the act of traction/dissection. Also to help in alleviating such traction discomfort we give the patient additional boluses of sedative analgesia in the form of intravenous alfentanil/midazolam. Such conscious anaesthesia was also advantageous in enabling us monitor recurrent laryngeal nerve through verbal communication with the patient and phrenic nerves through diaphragmatic motion that could be observed when cauterization or dissection nears the phrenic nerves which approximate the gland at its mid-portion. The only appreciable event in the outcome of this study was the single case of unilateral phrenic nerve palsy, noted by the raised cupula of the right hemidiaphragm on immediate post-operative chest X-ray, that resolved spontaneously in the next day film, this was only a radiologic finding with no significant clinical effect and can be explained in view of Pendit et al who demonstrated that the dye injected above the prevertebral layer of deep cervical fascia permeates through the pores where the nerves pierce the fascia, ending in the deep cervical space, so local anaesthetic injected in superficial cervical block may permeates deeply and anaesthetize phrenic nerve [25].

In conclusion: We can for the first time, report the feasibility and safety of trans-cervical thymectomy under local anaesthesia; An addition that seems to potentially deserve consideration in the management of MG.

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