

Original Article

Diagnosis and surgical treatment of giant goiter

Yan Jiang, Bo Gao, Jianjie Zhao, Shu Zhang, Lingji Guo, Wuguo Tian, Shuai Hao, Jie Yan, Yan Xu, Donglin Luo

Department of Breast & Thyroid Surgery, Research Institute of Surgery, Daping Hospital, The Third Military Medical University, Chongqing 400042, China

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Abstract: Objective: This study aimed to summarize the experience in diagnosis and surgical treatment for giant goiter. Methods: The clinical features of 66 patients with giant goiter were retrospectively reviewed, and the perioperative management, postoperative complications and treatments were summarized. Results: All the patients received surgical treatment: total thyroidectomy in 46 patients, bilateral subtotal thyroidectomy in 4, unilateral thyroid lobectomy in 14, and total thyroidectomy combined with cervical central lymph node dissection in 2 for thyroid cancer. Cervical incision was made in 61 patients, and surgery through cervical and thoracic incision was performed in 5. The patients were pathologically diagnosed with bilateral nodular goiter (n=50), unilateral nodular goiter (n=10), unilateral simple goiter (n=4), and thyroid papillary carcinoma (n=2). Thyroid crisis, dyspnea and other severe complications were not observed after surgery. Postoperative bleeding was found in 4 patients, hoarseness in 6 and drinking choke in 4, but all recovered within one week. Five patients developed lip numbness and limb twitching, but recovered within one month after calcium treatment. All patients were followed up for 6 months to 10 years. Patients receiving thyroidectomy were treated with oral thyroxine sodium, and recurrence was not observed. Conclusion: The preoperative diagnosis of giantgoiter is relatively easy, and ultrasound examination and computerized tomography are helpful for the definite diagnosis. The clinicians should understand the surgical indications and rational perioperative management. Total thyroidectomy or unilateral lobectomy is preferred for giantgoiter. The prevention against intraoperative injury to the blood vessel, trachea, esophagus, nerves and parathyroid is a key for successful surgery.

Keywords: Giant tumor, perioperative period, surgical treatment, complications

Introduction

The goiter of >III degree or thyroid tumor larger than 10 cm in diameter is also clinically known as giant goiter [1]. Retrosternal goiter refers to the enlarged thyroid retrosternally extending from the neck to the thoracic inlet [2]. Giant goiter can reach higher than the ipsilateral mandibular angle, extend downward to the thoracic inlet and substernal area and stretch to the deep and posterior sternoclavicular papillary muscle. If the surgical intervention is conducted in appropriately, it is easy to cause many complications, especially the bleeding, tracheal collapse, esophageal injury, parathyroid injury, nerve injury and others [3-5], significantly affecting the quality of life of these patients. In this study, we retrospectively summarized the clinical characteristics and surgical treatments in 66 giant goiter patients who received surgical intervention in our department between 2000 and 2015.

Clinical data and methods

General data

The tumor diameter ranged from 10 cm to 23 cm, and 19 patients were diagnosed with substernal goiter. There were 27 males and 39 females. The median age was 52 years (range: 15-74 years) and the course of disease ranged from 2 years to 30 years. In all the patients, a mass was found in the anterior cervical region on palpation. Preoperative diagnosis was confirmed by ultrasound examination and computerized tomography (CT). Of these patients, 6 had a history of thyroid surgery, and postoperative pathological examination showed nodular goiter.

Clinical manifestations

All the patients were admitted due the mass in the anterior cervical region. On palpation, the

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Table 1. Clinical manifestations (n=66)

Clinical manifestations	Number	Percentage (%)
Cervical mass	66	100
Cough	58	87.88
Dyspnea	19	28.79
Chest tightness and chest oppressive feeling	6	9.09
Chest pain	2	3.03
Hoarseness	3	4.55
Headache & dizziness	10	15.15
Swallowing discomfort	12	18.18
No symptom	6	9.09

mass was 10 cm-23 cm in diameter, and had intermediate texture and unclear boundary. Of 66 patients, 58 presented symptoms of tracheal compression (cough, difficulty breathing, chest tightness, chest oppressive feeling and chest pain); 3 had hoarseness; 12 had swallowing discomfort; 10 had varying degrees of headache or dizziness; 6 had no obvious discomfort (**Table 1** and **Figure 1**).

Thyroid function tests

Increase in thyroid stimulating hormone (TSH) was found in 36 patients and reductions in free triiodothyronine (FT3) and free thyroxine (FT4) in 28. In remaining patients, the FT3, FT4, TSH and results of blood examinations were normal.

Imaging examinations

All the patients received ultrasound examination and CT. Ultrasound examination showed that thyroid was enlarged, nodules with hypointense of different degrees were found in the thyroid, the boundary was clear, and blood flow signal was observed. Nodules with calcification were found in 5 patients. On plain CT scan, the lesions were limited, while they showed different degrees of enhancement on enhanced scanning. In addition, tracheal compression and displacement were found in 58 cases, and tracheal stenosis in 42. The anterior-posterior and lateral chest X-ray was performed to confirm the severity of tracheal compression and the difference in trachea diameter at inspiratory phase and expiratory phase larger than 5 mm is suggestive of tracheomalacia. In this study, tracheomalacia was considered in 5 patients. On CT, retrosternal giant goiter was

characterized by the presence of mediastinal mass, thyroid enlargement, inhomogeneous density and inhomogeneous enhancement of the thyroid and the trachea moved contralaterally (**Table 2** and **Figure 2**).

Laryngoscopy

To observe the position and activity of bilateral vocal cords, laryngoscopy was conducted in 66 patients before surgery. In 2 patients with postoperative recurrence, unilateral vocal cord fixation was found and glottis closure was not favorable. The vocal cord function was normal in remaining patients.

Fine needle aspiration biopsy

In 5 patients with concomitant thyroid calcification, fine needle aspiration cytology guided with ultrasound was performed, and papillary thyroid cancer was found in 2 patients by pathological examination.

Surgical procedures

Total thyroidectomy was performed in 46 patients, bilateral subtotal thyroidectomy in 4, unilateral thyroid lobectomy in 14, and total thyroidectomy combined with cervical central lymph node dissection in 2 due to thyroid cancer. Cervical incision was made in 61 patients and surgery through the cervical and thoracic incision was performed in 5 (**Figures 3-5**).

Results

Postoperative pathological diagnosis

Post-operative pathological examination showed bilateral nodular goiter in 50 patients, unilateral nodular goiter in 10, unilateral simple nodular goiter in 4 and papillary thyroid cancer in 2.

Postoperative complications

Postoperative severe tracheomalacia and collapsed hypocalcemia were found in 1 patient, then tracheotomy and mechanical ventilation were performed, and extubation was prescribed seven days later. Thyroid crisis, difficult breathing and other severe complications were



Figure 1. Large masses in the anterior cervical region.

Table 2. Imaging examinations (n=66)

Imaging examinations	Number	Percentage (%)
Nodules with calcification	5	7.58
Tracheal compression and displacement	58	87.88
Tracheal stenosis	42	63.64
Tracheomalacia	5	7.58
Mediastinal mass	19	28.79

not observed after surgery. Postoperative bleeding was found in 4 patients with the blood loss of 200-600 ml. Hoarseness was found in 6 patients and drinking choke in 4, but all recovered within one week. Lip numbness and limb twitching were noted in 5 patients, but they recovered within one month after calcium treatment (**Table 3**).

Postoperative follow-up

All patients were post-operatively followed up for 6 months to 10 years. Patients receiving total thyroidectomy were treated with oral thyroxine sodium, and recurrence was not observed. Routine postoperative treatment with thyroxine sodium tablets last for 3-6 months, the T3 and T4 were maintained at the upper limit of normal and the hypersensitive thyroid stimulating hormone (hTSH) at 0.1-0.5 μ U/ml.

Discussion

In view of the special anatomical location of the thyroid, inappropriate peri-operative treatment of thyroid diseases may cause some complications such as bleeding, difficult breathing, parathyroid injury, nerve injury and other complications [6], significantly affecting the quality of

life of these patients. The giant goiter may compress the major vessels, trachea, esophagus and other tissues in the neck, which alter the locations of these tissues and organs in the neck, increasing the surgical difficulty, operative risk and intraoperative & postoperative incidences of complications [7]. Thus, clinicians should understand the surgical indications to giant goiter, and

rational peri-operative management is a key to the successful surgery.

Operative indications

Generally, giant goiter has a long course, is mainly benign, predominantly presents expansive growth, and requires surgical treatment. Operative indications to giant goiter include: 1) Bilateral nodular goiter compresses the trachea, causing shortness of breath at a supine position; 2) Multiple nodular goiter with secondary hyperthyroidism is non-responsive to long-term pharmacotherapy; 3) Recently, the tumor grows rapidly and has a high risk for canceration; 4) The giant thyroid tumor affects the appearance.

Preoperative assessment

The giant mass is rich in blood, the blood vessels and nerves are compressed and the mass has a poor activity, which significantly increase the difficulty of surgery. Thus, sufficient preoperative assessment is extremely important: 1) Preparation of red blood cell suspension; 2) Preoperative routine blood test and examinations of the heart, lung, kidney function and coagulation function. 3) Cervical X-ray exam, CT and upper gastrointestinal barium meal exami-

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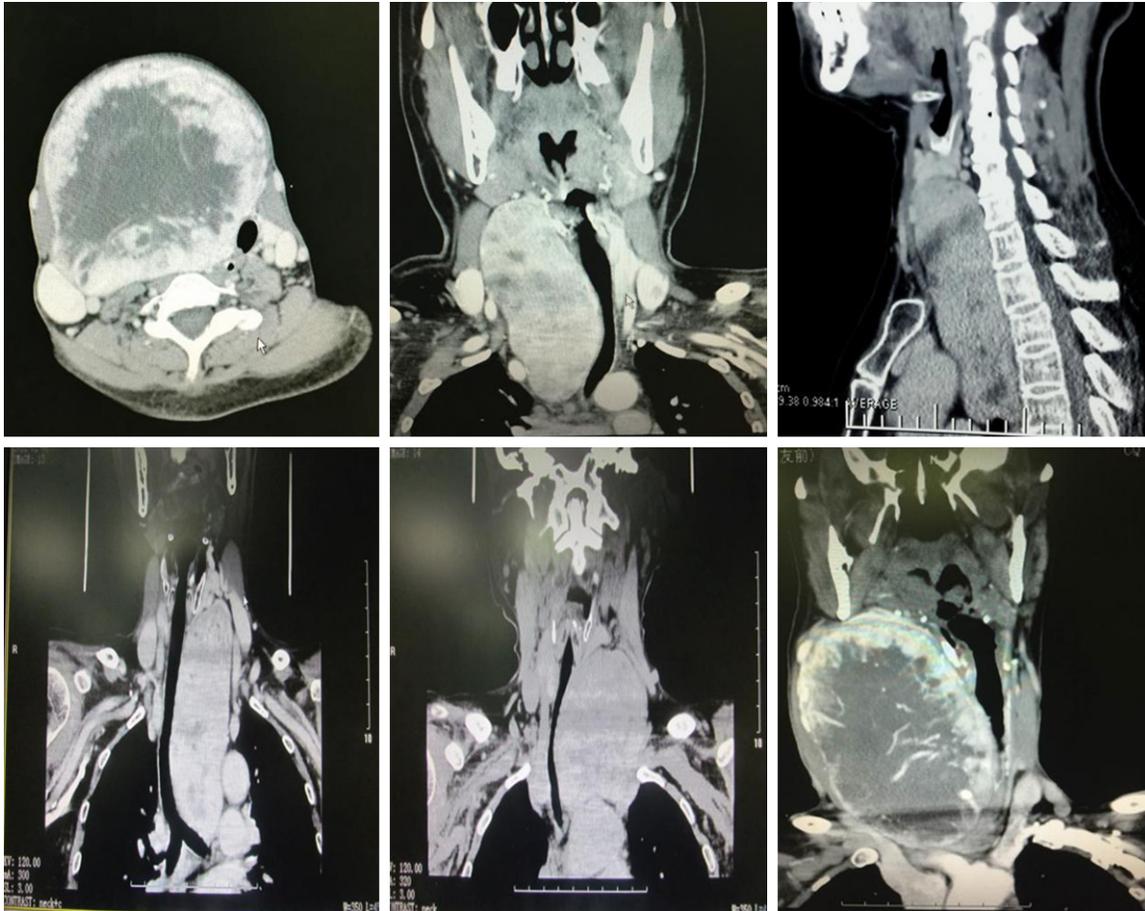


Figure 2. CT of the neck: thyroid was enlarged significantly, the trachea was deformed and displaced due to compression, and become stenotic.

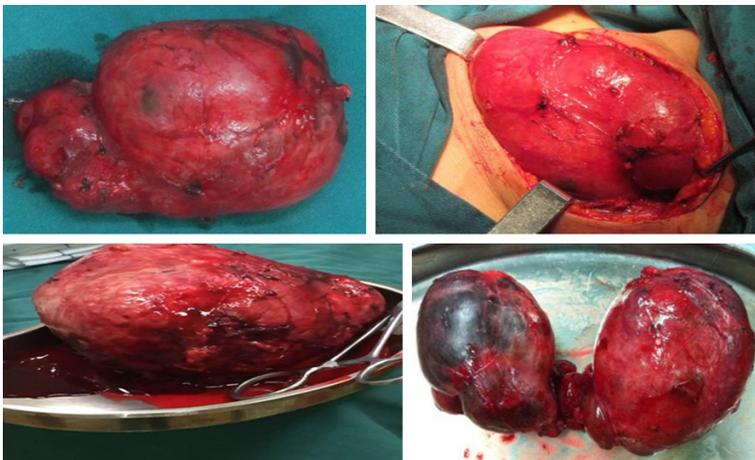


Figure 3. Macroscopic giant nodular goiter (Cervical curved incision).

nation are necessary to confirm compression induced deformation of the trachea and esophagus [8]. 4) Laryngoscopy may be conducted to

identify the movement of bilateral vocal cords. 5) Patients with concomitant hyperthyroidism require regular preoperative management (medication with tapazole, iodine, propranolol or other drugs) to control the heart rate at 90 beats/min and basal metabolic rate (BMR) at <20%-30%.

Anesthesia methods

Giant goiter patients often have tracheal displacement and deformation as well as tracheal luminal stenosis due to mass related compression, which make intraoperative anesthetic incubation difficult [9]. Thus, it is important to comprehensively

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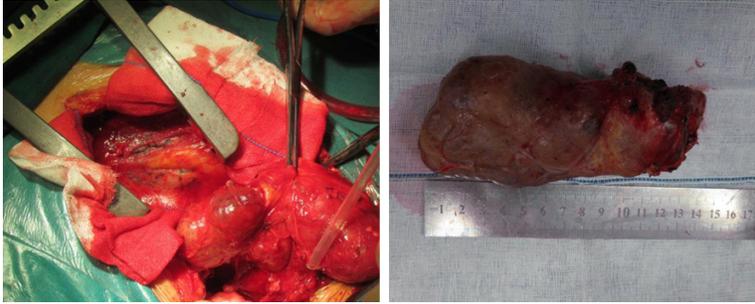


Figure 4. Macroscopic substernal giant nodular goiter (Cervical- thoracic “T” incision).



Figure 5. Postoperative appearance of the incisions.

Table 3. Postoperative complications (n=66)

Postoperative complications	Number	Percentage (%)
Hoarseness	6	9.09
Choking cough	4	6.06
Transient hypocalcemia	5	7.57
Tracheomalacia	1	1.52
Thyroid crisis	0	0
Postoperative bleeding	4	6.06

assess the tracheal compression before operation. Because of the giant tumor, all the patients received tracheal intubation at awake state. General anesthesia was administered once tracheal intubation was successfully completed. In our report, intubation was not performed due to the severe tracheal stenosis in 2 patients, and thus the surgery was conducted under extracorporeal circulation. Once the tracheal compression was relieved, intratracheal intubation was performed to ensure the safety of surgery.

Selection of incision and surgical procedures

Cervical hyperextension was employed during the surgery, and the incision should maximize

the exposure of the thyroid. In our study, a cervical curved incision was used with both ends slightly higher. If the lower edge of the mass extends to the sternum, the incision should be made at lower neck. In case of huge mass, an “L”-shaped incision may be used; in case of intrathoracic goiter, a “T”-shaped incision may be employed. Total thyroidectomy and unilateral lobectomy are the main methods of surgery because the normal thyroid is very small and has limited function in patients with giant goiter, the partial resection of the thyroid may increase the residual tissues, leading to elevated risk for postoperative recurrence, and the second surgery is very difficult and not only brings pain to patients, but increases their economic burden; patients

are often a little old and usually have concomitant internal disease, and postoperative replacement therapy may not affect the quality of life; In a smaller proportion of patients, the course of disease is very long, and they have elevated risk for canceration; it may lead to en bloc resection and has less blood loss in surgery.

Management of blood vessels in the thyroid

The giant goiter is rich in blood, the superficial blood vessels enlarge and have a large amount of branches, and the gland is often adherent to the major vessels in the neck. Thus, inappropriate management may cause bleeding and increase the difficulty of operation. Because of rich blood supply to the upper pole of the thyroid, double ligation or suture is necessary to avoid heavy bleeding in the deal with blood vessels. If there was no gap between upper pole of the gland and mandibular angle, the lower pole and isthmus should be treated first, followed by the treatment of lateral gland. When dealing with the thyroid inferior artery, its branches should be ligated at the site close to the thyroid and its main vessel should not be ligated, which not only achieve hemostasis, but may not cause damage to the parathyroid and recurrent

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laryngeal nerve (RLN). Post-operative bleeding was found in 4 patients, and the blood loss was 200-600 ml. Immediately, the wound was exposed, the sites of bleeding or hemorrhage were identified for further hemostasis by suture and thus serious consequences were not present after surgery. At present, the ultrasonic scalpel may be used in dealing with the superficial vessels, which may reduce bleed loss, assure a clear surgical field, completely expose and protect the RLN, significantly shorten the operation time and reduce the incidence of complications. The substernal giant goiter is rich in blood, the surgery through a cervical incision has limited space for operation, and conventional hemostasis by ligation is very difficult under this condition. Thus, once the site of bleeding locates inside the thorax, it is difficult for hemostasis. Under this condition, sternotomy is needed. Intraoperative use of ultrasound scalpel solves this problem. The ultrasonic scalpel can be used for separation, cutting and hemostasis in a small space, which is convenient for the surgical intervention of substernal goiter through the cervical incision. In this study, substernal goiter excision through the cervical incision was successfully conducted with the help of ultrasonic scalpel in 10 patients, the intra-operative blood loss was less, none required blood transfusion, few post-operative complications were observed, and post-operative massive haemorrhage and thyroid crisis were not observed. Only one patient had transient limb twitching. Thus, we speculate that substernal goiter excision with the help of ultrasound scalpel via a cervical incision may reduce surgical injury, decrease post-operative complications [10] and achieve rapid post-operative recovery without compromising the therapeutic efficacy.

The protection of parathyroid

Postoperative hypoparathyroidism is not uncommon after surgery for giant goiter, which is usually caused by the missed resection of the parathyroid, or the damage to the parathyroid or its blood supply. The assurance of the integrity of thyroid capsule during the operation is important for the protection of the parathyroid. Therefore, ligation of the thyroid inferior artery is not recommended, [http://dict.youdao.com/w/inferior artery/javascript:void\(0\);](http://dict.youdao.com/w/inferior%20artery/javascript:void(0);) aiming to protect the thyroid capsule and preserve

the loose tissues at the lower pole of the thyroid. Specimens collected should be examined carefully. If parathyroid is found in the specimens, the parathyroid should be cut into 1 mm×1 mm blocks and then transplanted into the sternoclavicular papillary muscle or deltoid muscle [11].

The protection of recurrent laryngeal nerve (RLN)

RLN injury is the most common but serious complication of the thyroid surgery, its incidence is reported to be 0.5%~5% [12], and the unilateral RLN injury is more common. Of note, the incidence of RLN injury is higher after retrosternal goiter surgery. The key to avoid and reduce RLN injury is prevention. The operation should be gentle, the retraction of the thyroid tissue should be avoided, and cautions should be taken in the operation at the site of RLN. Intraoperative nerve monitoring can effectively reduce the incidence of RLN damage [13]. For giant goiter, there is still controversy on the intraoperative RLN exposure. We speculate that the surgeon should not intentionally expose the RLN and should preserve the posterior thyroid capsule to avoid the injury to the RLN.

Tracheomalacia treatment

After long term compression of the trachea by the giant goiter, the trachea will lose the support when the tumor is removed and thus the tracheal wall is prone to soften and collapse. In severe cases, it will cause suffocation severely. Therefore, the clinicians should emphasize the tracheomalacia after surgery for giant goiter. Preoperative X-ray of the trachea is helpful for the identification of severity of tracheal compression. The difference in the trachea diameter at inspiratory phase and expiratory phase higher than 5 mm is suggestive of tracheomalacia. In this study, tracheomalacia was considered in 5 patients, and intraoperative tracheal suspension was performed. Of note, the suspension should be strong enough so that the trachea will not collapse when the patient breathes deeply; the suspension must be perpendicular to the softened trachea; the tracheal lumen should not be penetrated during the suture; in case that the suspension is not acceptable, tracheotomy should be performed; in the removal of the suspension wires, clinicians

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should first observe the patient's breath after releasing the wires, and removal of the wires may be conducted once difficult breathing is not observed.

Treatment for retrosternal giant goiter

When the tumor is small, the lower pole of the thyroid is bluntly separated with fingers, and then the tumor is supported outward and resected. When the tumor is big, the tumor should be completely freed and retracted upward, then the thyroid capsule is bluntly separated, and the vessels at the lower pole of the thyroid are treated macroscopically. When the goiter is cystic, the cystic fluid should be aspirated to reduce the tumor size for further resection. The sharp and blunt separation of the lower pole of the intrathoracic goiter should be done alternately close to the capsule. The blood vessels of the lower pole are difficult to expose, forced separation and ligation should not be avoided and otherwise, it will cause hemorrhage and pneumothorax. If the lower pole is difficult to expose, the tumor may be slightly retracted upward with a 7# silk suture at the lower pole of the thyroid for the subsequent blunt separation. Multiple ligations may be administered if necessary until the complete resection of intrathoracic tumor is feasible. If the tumor is very large and has a long course and preoperative enhanced CT showed substernal tumor with unclear boundary or adhesion to mediastinal major vessels, operation is easy to cause damage to the vessels. Under this condition, an incision may be made at the center of the sternum to completely expose the tumor, which is then resected macroscopically. In this study, half of the sternum was separated in the presence of an incision at the lower neck, which assured the safety.

Patients with giant goiter frequently present compression related symptoms, secondary hyperthyroidism or even cancerization. Once the diagnosis is confirmed, surgical treatment should be performed as soon as possible, which may achieve a good prognosis. After surgery, routine treatment with levothyroxine sodium is required to prevent post-operative recurrence. Regular examination is also important for the adjustment of pharmacotherapy.

Disclosure of conflict of interest

None.

Address correspondence to: Donglin Luo, Department of Breast & Thyroid Surgery, Research Institute of Surgery, Daping Hospital, The Third Military Medical University, Chongqing 400042, China. E-mail: yanjie1986514@163.com

References

- [1] Pradeep PV, Sattar V, Krishnachaithanya K and Ragavan M. Huge thyromegaly: challenges in the management. *ANZ J Surg* 2011; 81: 398-400.
- [2] White ML, Doherty GM and Gauger PG. Evidence-based surgical management of substernal goiter. *World J Surg* 2008; 32: 1285-1300.
- [3] Morton RP, Mak V, Moss D, Ahmad Z and Sevaio J. Risk of bleeding after thyroid surgery: matched pairs analysis. *J Laryngol Otol* 2012; 126: 285-288.
- [4] Kandil E, Noureldine SI, Abbas A and Tufano RP. The impact of surgical volume on patient outcomes following thyroid surgery. *Surgery* 2013; 154: 1346-1352; discussion 1352-1343.
- [5] Calo PG, Pisano G, Piga G, Medas F, Tatti A, Donati M and Nicolosi A. Postoperative hematomas after thyroid surgery. Incidence and risk factors in our experience. *Ann Ital Chir* 2010; 81: 343-347.
- [6] Christou N and Mathonnet M. Complications after total thyroidectomy. *J Visc Surg* 2013; 150: 249-256.
- [7] Steurer M, Passler C, Denk DM, Schneider B, Niederle B and Bigenzahn W. Advantages of recurrent laryngeal nerve identification in thyroidectomy and parathyroidectomy and the importance of preoperative and postoperative laryngoscopic examination in more than 1000 nerves at risk. *Laryngoscope* 2002; 112: 124-133.
- [8] Nygaard B, Nygaard T, Court-Payen M, Jensen LI, Soe-Jensen P, Gerhard Nielsen K, Fugl M and Hegedus L. Thyroid volume measured by ultrasonography and CT. *Acta Radiol* 2002; 43: 269-274.
- [9] Agarwal A, Agarwal S, Tewari P, Gupta S, Chand G, Mishra A, Agarwal G, Verma AK and Mishra SK. Clinicopathological profile, airway management, and outcome in huge multinodular goiters: an institutional experience from an endemic goiter region. *World J Surg* 2012; 36: 755-760.
- [10] Manouras A, Markogiannakis H, Koutras AS, Antonakis PT, Drimousis P, Lagoudianakis EE, Kekis P, Genetzakis M, Koutsoumanis K and Bramis I. Thyroid surgery: comparison between the electrothermal bipolar vessel sealing sys-

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- tem, harmonic scalpel, and classic suture ligation. *Am J Surg* 2008; 195: 48-52.
- [11] Delbridge L. How to preserve all four parathyroid glands. *Contemporary Surgery* 2007; 63: 125-126.
- [12] Tresallet C, Chigot JP and Menegaux F. [How to prevent recurrent nerve palsy during thyroid surgery?]. *Ann Chir* 2006; 131: 149-153.
- [13] Marcus B, Edwards B, Yoo S, Byrne A, Gupta A, Kandreas J, Bradford C, Chepeha DB and Teknos TN. Recurrent laryngeal nerve monitoring in thyroid and parathyroid surgery: the university of Michigan experience. *Laryngoscope* 2003; 113: 356-361.