

Thyroid Surgery—The Tan Tock Seng Hospital Otolaryngology Experience

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Abstract

Introduction: Central to the management of a patient with a thyroid nodule is the evaluation of the risk of malignancy. Postoperative morbidity, though rare, remains a concern because of its impact on the quality of the life of the patient. **Materials and Methods:** A retrospective audit of 91 consecutive patients who underwent thyroid surgery for thyroid nodules, at the Department of Otolaryngology, Tan Tock Seng Hospital, between January 1995 and December 2000. **Results:** The sensitivity and specificity of fine-needle aspiration cytology (FNAC) were 60% and 100%, respectively. The sensitivity and specificity of intraoperative frozen section examination was 82% and 100%, respectively. Sixty-four patients experienced no postoperative morbidity. Of the 27 patients with postoperative morbidity, only 1 was permanent. The incidence of transient and permanent biochemical hypocalcaemia was 44% and 0%, respectively. Nodal dissection performed together with total thyroidectomy increased the incidence of postoperative hypocalcaemia ($P < 0.05$). The number of parathyroid glands preserved in situ did not predict for postoperative hypocalcaemia. The incidence of transient and permanent recurrent laryngeal nerve (RLN) palsy was 10.3% and 1.1% (8.2% and 0.9% of nerves at risk), respectively. Tracheo-oesophageal groove clearance performed together with thyroid lobectomy did not increase the incidence of postoperative RLN palsy ($P > 0.05$). The median hospital stay was 3 days for benign thyroid disease, 4.5 and 16 days for malignant disease with tracheo-oesophageal groove clearance only and with neck dissection, respectively. **Conclusion:** The combination of clinical examination and FNAC remains the mainstay in selecting patients for surgery. Frozen section examination is an important intraoperative diagnostic adjunct to decide the extent of surgery. With proper surgical training and experience, thyroid surgery for malignancy can be undertaken with minimum postoperative morbidity and a short hospital stay.

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Key words: Fine-needle aspiration cytology, Hypocalcaemia, Intraoperative frozen section analysis, Postoperative morbidity, Recurrent laryngeal nerve palsy

Introduction

The solitary thyroid nodule is a common clinical finding in the Otolaryngology practice. Although most lesions are ultimately shown to be benign, the management of the patient with a thyroid nodule remains a clinical challenge because of the 5% to 10% risk of malignancy.^{1,2}

Thyroid carcinoma is the ninth most common malignancy in Singapore females, with a 3.4-times higher incidence rate compared to males. In the period from 1993 to 1997, there were 611 reported cases of thyroid carcinoma amongst the Singapore resident population. The differentiated thyroid carcinomas, papillary and follicular, accounted for more than 89% of these cases.³

Fine-needle aspiration cytology (FNAC) has become the diagnostic procedure of choice in the evaluation of thyroid nodules. It affords greater accuracy over clinical and non-invasive laboratory investigations in diagnosing the nature of thyroid nodules, and provides the justification for

observing nodules that are likely benign, and intervening surgically for nodules with a higher risk of malignancy. With the use of FNAC, it is possible to reduce the proportion of patients recommended for surgery to 20%, and increase the yield of malignancy in resected lesions to 50%.⁴

An inconclusive result on FNAC frequently prompts the surgeon to utilise intraoperative frozen section examination during thyroid lobectomy to decide the extent of surgery. However, the limited sampling and process-inherent tissue artifacts of frozen sections have raised concerns about its reliability in diagnosing malignancy.

Complications following thyroid surgery depend on multiple factors, including the extent of the disease, the complexity of the surgical procedure, as well as the training and expertise of the surgeon. In experienced hands, complications following routine thyroid surgery are uncommon. Though often perceived as inconveniences, postoperative complications can pose significant problems

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and influence the quality of life and survival.

Materials and Methods

Ninety-one patients underwent thyroid surgery for thyroid nodules at the Department of Otolaryngology, Tan Tock Seng Hospital between January 1995 and December 2000.

Data Collection

A retrospective chart review was performed for data regarding the biodata, the source of referral, the number and size of nodules, the presence of cervical lymphadenopathy, and endoscopic findings of preoperative and postoperative recurrent laryngeal nerve (RLN) function. Charts for the following diagnostic tests were also reviewed: FNAC, ultrasonography, radionuclide scan, computed tomography (CT), free thyroxine (FT4), thyroid stimulating hormone (TSH), thyroid antibodies and serum thyroglobulin (Tg).

Similarly, operative records were examined for the extent of surgery, the surgeon grade, intraoperative identification and preservation of the RLNs and parathyroid glands, intraoperative frozen section examination, the final histopathologic diagnoses, postoperative morbidity and length of hospital stay.

Histology

Each FNAC result was classified into 1 of 3 categories: *malignant*, *benign* and *suspicious*. Suspicious FNAC results included those that showed atypical cellular changes suggestive of, but not diagnostic of carcinoma, as well as follicular neoplasms. Similarly, frozen section results were classified into 3 categories: malignant, benign and deferred. Deferred frozen sections were cases in which the histopathologist advised awaiting paraffin section examination. The results of the FNAC and frozen section were compared to the final histopathologic diagnoses. Histopathologic confirmation of malignancy in the FNAC and frozen section diagnostic categories of malignancy was regarded as true positives. The suspicious and deferred categories were omitted from this analysis. The remaining FNAC and frozen section results were classified as true negatives, false positives or false negatives. The sensitivity, specificity, positive predictive value, negative predictive value, and accuracy of FNAC and frozen section for detecting malignancy were then determined.

Complications

Biochemical hypocalcaemia was defined as a serum ionised calcium concentration of less than 2.10 mmol/L, and clinical hypocalcaemia by the presence of one or more of the following symptoms or signs: perioral or fingertip numbness or paraesthesia, positive Chvostek sign or positive

Trousseau sign. Permanent hypoparathyroidism was defined functionally on the basis of requirement of calcium supplementation 1 year after surgery. The incidence of hypocalcaemia was charted against the nature of the disease, the extent of resection and the number of parathyroid glands preserved.

Postoperative cord palsy was defined as the presence of an immobile vocal cord, or decreased movement of the vocal cord during phonation. Patients identified with postoperative recurrent nerve palsy were followed up with periodic vocal cord examination and speech therapy until full recovery was documented. RLN palsy that persisted 1 year after the operation was regarded as permanent. The incidence of postoperative RLN palsy was calculated in relation to the number of patients, as well as the number of nerves at risk, and charted against the nature of the disease and the extent of resection.

Statistical Analysis

Statistical analysis was performed using the Fisher's exact test. Statistical significance was set at $P < 0.05$.

Results

Ninety-one patients underwent thyroid surgery for thyroid nodules during the study period. An increasing trend was observed in the number of thyroid lobectomies performed, year on year. The majority of operations (93%) were performed or overseen by a single otolaryngology consultant (JKS), with residents operating under his supervision (52%).

There were 27 males (range, 34 to 72 years; median, 55 years) and 64 females (range, 21 to 85 years; median, 46 years) in this study. The racial distribution of the study population approximates the Singapore resident population in census year 2000 with 76% Chinese, 8% Malays, 11% Indians and 5% other races.

Primary health care physicians referred 64% of the patients in our study. General (11%) and emergency medicine (8%) physicians, endocrinologists (2%) and other clinical specialists (3%) accounted for 24% of the referrals, whilst an otolaryngologist (1%) and general surgeons (2%) accounted for only 3%. Four per cent of the patients were self-referrals. The source of referral for the remaining 5% of patients could not be determined with certainty.

Seventy-four (81%) of our patients presented with a solitary thyroid nodule. The remaining 17 patients (19%) had multinodular glands. The nodules ranged in size from 1 to 8 cm, with a median of 2.0 cm. Malignant nodules ranged from 1 to 4.5 cm, with a median of 2.0 cm. Eight patients had upper aerodigestive compressive symptoms. Seven of the patients had palpable cervical lymphadenopathy in the lateral neck at the time of presentation. All

7 subsequently had metastatic nodal disease proven on neck dissection. Preoperative unilateral RLN palsy was diagnosed in 8 (9%) patients—6 with malignant tumours and 2 with benign disease.

Diagnostic Tests

Sixty (66%) of our patients with thyroid nodules had FNAC and 67 (74%) had frozen section. In contrast, only 25 (27%) of our patients had thyroid ultrasonography, of whom 17 (19%) had concomitant radionuclide scans. Thirty-nine (43%) patients were evaluated with CT. All patients had FT4 and TSH assays prior to surgery. The screening for thyroid antibodies was selectively performed when there was a history of hyperthyroidism (3) or suspected autoimmune thyroiditis (1). Serum thyroglobulin was assayed in 4 patients.

FNAC

Fine-needle aspiration was performed on 60 patients. Six patients (10%) were diagnosed with papillary carcinoma, 20 (33.3%) had benign thyroid disease, 26 (43.3%) had suspicious findings [2 (3.3%) atypical cellular changes and 24 (40%) follicular lesions] and 8 (13.3%) had specimens that were unsatisfactory for cytologic diagnosis. All 6 cytologic positive diagnoses of carcinoma were confirmed on final histopathology. Of the 24 follicular lesions, there were 2 papillary carcinomas, 5 follicular adenomas, 14 hyperplastic goiters, 2 colloid nodules and 1 granulomatous thyroiditis. Paraffin section examination revealed 4 (7%) false negatives in the group diagnosed with benign thyroid disease.

Among the 26 patients with a FNAC that was reported as clearly malignant (6) or benign (20), the sensitivity, specificity and diagnostic accuracy of FNAC for detection of malignancy were 60%, 100% and 77%, respectively (positive predictive value, 100%; negative predictive value, 80%).

Surgical Procedures

Unilateral thyroid lobectomy was performed on 57 (63%) patients, completion total thyroidectomy by unilateral lobectomy in 4 (4%), near total thyroidectomy in 4 (4%), total thyroidectomy in 23 (25%), isthmusectomy in 1 (1%) and nodulectomy in 2 (2%) patients. Identification of the RLNs and a systematic search for the parathyroid glands with their blood supply were routine in all operative procedures.

In JKS' practice, unilateral thyroid lobectomy was the minimal intervention for a suspicious thyroid nodule. Total thyroidectomy was performed for all well-differentiated thyroid carcinoma larger than 4 cm. Ipsilateral tracheo-oesophageal groove (TEG) clearance was routinely

performed for papillary thyroid carcinoma. Ipsilateral neck dissection was performed when there was evidence of nodal disease of the lateral compartment. In total, tracheo-oesophageal groove clearance was performed in 23 (25%) patients, including 9 (10%) patients who had ipsilateral neck dissections. One patient underwent total laryngectomy because of extensive laryngotracheal tumour invasion.

Intraoperative Frozen Section Examination

Frozen section examination was performed on 67 patients and malignancy was reported in 9 (13%). All 9 patients underwent one-stage total thyroidectomy. Of the remaining 58 patients, frozen section demonstrated benign thyroid disease in 38 (57%) and follicular lesions in 20 (30%). When the frozen section results were classified as deferred, 2 (10%) out of 20 demonstrated papillary thyroid carcinoma on final histopathology. There were 2 (3%) false negatives in the 38 patients reported to have benign thyroid disease on FNAC. All 4 patients had completion total thyroidectomy performed.

In the 47 patients where frozen section provided a malignant (9) or benign (38) result, the sensitivity, specificity and diagnostic accuracy of frozen sections for the detection of malignancy were 82%, 100% and 96%, respectively (positive predictive value, 100%; negative predictive value, 95%).

FNAC versus Intraoperative Frozen Section Examination

Forty-seven of 60 patients with FNAC subsequently had frozen section. Eight patients had FNAC inadequate for diagnosis. Cytopathology reports of the remaining 39 patients were classified as malignant in 3 patients, benign in 14 and suspicious in 22.

For the 3 patients where FNAC was classified as malignant, frozen section and paraffin section were also interpreted as malignant. In the 14 patients with FNAC classified as benign, frozen section was interpreted as benign in 8, and this correlated with a benign paraffin section in all but 1 case; in 5 patients, frozen section failed to resolve the nature of the follicular lesion. Overall, there were 3 false-negative FNAC results: one correctly identified with frozen section, one false-negative frozen section and the last with a follicular lesion reported on frozen section.

Twenty of 22 patients with suspicious cytology had follicular lesions on FNAC and 2 had atypical cellular changes. In the subgroup with follicular lesions, frozen section correctly identified 2 patients (10%) with malignancy. In 9 patients (45%), the nature of the follicular lesion remained unresolved with frozen section. Nonetheless, paraffin section proved all to be benign—3 follicular adenomas, 4 hyperplastic nodules and 2 colloid nodules. For the remaining 9 patients (45%) with benign

disease reported on frozen section, there were 8 hyperplastic nodules, 1 colloid nodule and 1 thyroiditis. Of the 2 patients with atypical cellular changes on FNAC, both had follicular lesions on frozen section, with the final paraffin section reported as papillary thyroid carcinoma in one and follicular adenoma in the other.

Eight patients had FNAC inadequate for diagnosis. Frozen section examination demonstrated 7 as benign (with 1 false negative on paraffin section) and 1 as a follicular lesion.

Histopathologic Diagnoses

Seventy-two (72%) of the histopathologic diagnoses were benign and 19 (21%) were malignant. Of the malignant thyroid tumours, all were classified as papillary thyroid carcinomas, 3 of which were follicular variant papillary carcinoma. The finding of papillary carcinoma among follicular neoplasms is generally attributed to the follicular variant of papillary carcinoma.⁵

Morbidity of Thyroid Surgery

Sixty-four (70%) patients in this study experienced no postoperative morbidity. Of the remaining 27 (30%) patients with postoperative complications, most were transient, and only 1 had permanent morbidity. Transient postoperative complications were often of minor consequence and resolved spontaneously. Rarely did transient complications require clinical intervention.

There was 1 death from acute myocardial infarction on the seventh day, after radical surgery, following what was up to then an uneventful postoperative period. Airway obstruction from RLN palsy following unilateral thyroidectomy occurred in 1 patient with contralateral RLN palsy from a previous cerebrovascular accident. Tracheotomy was required on the third postoperative day.

Wound morbidity included 1 deep and 1 superficial haematoma, 1 seroma, 1 chyle leak, and 1 wound infection. The deep neck haematoma, together with ipsilateral RLN palsy, was noted on the third postoperative day and evacuated on the sixth postoperative day with no further complications. The superficial haematoma showed no progression and resolved without re-operation. A small seroma was noted on the fourteenth day following unilateral thyroid lobectomy when a patient underwent completion total thyroidectomy for papillary thyroid carcinoma. The chyle leak occurred after left-sided neck dissection. It ceased after 9 days of conservative treatment. The postoperative wound infection was opened and dressed through the initial surgical incision.

Hypoparathyroidism and Hypocalcaemia

A subgroup of 32 patients—29 bilateral lobectomies and 3 unilateral lobectomies with a history of contralateral

thyroid surgery—was analysed. The incidence of transient biochemical hypocalcaemia was 43.7%. Two patients experienced transient clinical manifestations of hypocalcaemia. Intravenous calcium replacement was instituted in 9 patients with serum calcium nadir of at least 1.8 mmol/L or clinical hypocalcaemia. Transient hypocalcaemia persisted up to 20 weeks, with a median of 4 weeks. None of our patients had permanent hypocalcaemia.

The incidence of hypocalcaemia was charted against the extent of surgery (Table I), histopathologic characteristics (Table II), and the number of parathyroid glands identified and preserved at surgery. Nodal dissection after total thyroidectomy increased the incidence of postoperative hypocalcaemia significantly ($P = 0.031$). Although surgery for thyroid malignancy appears associated with a higher risk of postoperative hypocalcaemia, this was not found to have statistical significance ($P = 0.165$) when compared to surgery for benign disease. Three or more parathyroid glands were identified and preserved in at least 44% of operations. The number of parathyroid glands preserved *in situ* did not predict for postoperative hypocalcaemia ($P = 0.466$), the need for postoperative calcium treatment or the final outcome of the hypocalcaemia.

RLN Palsy

Five patients were noted to have preoperative unilateral RLN palsy secondary to malignant involvement—all 5 patients subsequently had total thyroidectomy performed.

TABLE I: INCIDENCE OF HYPOCALCAEMIA ACCORDING TO THE EXTENT OF SURGERY

Extent of surgery	No. of patients (n = 32)		
	Hypocalcaemia present	Hypocalcaemia absent	Total
Group I (with nodal dissection)			
Total thyroidectomy with TEG clearance and neck dissection	8	—	8
Total thyroidectomy with TEG clearance	2	5	7
Subtotal	10	5	15
Group II (without nodal dissection)			
Total thyroidectomy	3	7	10
Near total thyroidectomy	—	4	4
Completion thyroidectomy	1	2	3
Subtotal	4	13	17
Total	14	18	32

TEG: tracheo-oesophageal groove
Fisher's exact test = 0.031

TABLE II: INCIDENCE OF HYPOCALCAEMIA ACCORDING TO THE HISTOPATHOLOGIC CHARACTERISTICS

Histopathologic diagnosis	No. of patients (n = 32)		Total
	Hypocalcaemia present	Hypocalcaemia absent	
Group I (malignant)			
Papillary carcinoma	10	8	18
Subtotal	10	8	18
Group II (benign)			
Nodular hyperplasia	3	5	8
Adenoma	1	—	1
Hashimoto's thyroiditis	—	4	4
Colloid nodule	—	1	1
Subtotal	4	10	14
Total	14	18	32

Fisher's exact test = 0.165

In each case, the ipsilateral RLN was sacrificed because of tumour encasement found at surgery. The patient with preoperative unilateral RLN palsy and laryngotracheal tumour invasion required total laryngectomy, and was excluded from this analysis.

The remaining 87 patients form the cohort of this analysis—59 unilateral lobectomies and 28 bilateral lobectomies—with 110 nerves at risk of injury. The incidence of transient and permanent RLN palsy was 10.3% and 1.1% (8.2% and 0.9% of nerves at risk), respectively. The overall recovery rate of unexpected postoperative RLN palsy was 90%. The median duration for transient RLN palsy recovery was 2 months. The patient with permanent RLN palsy had a history of thyroid

cyst infection, with adhesions between the thyroid lobe and cricopharyngeal muscle noted intraoperatively. In spite of the ipsilateral RLN being positively identified and preserved, laryngeal electromyography⁶ at 10 months had failed to record an action potential in the affected thyroarytenoid muscle. Medialisation thyroplasty was performed at 11 months following thyroid lobectomy.

The incidence of transient and permanent RLN palsy was charted against the extent of surgery (Table III) and the histopathologic characteristics (Table IV). Tracheo-oesophageal groove clearance performed with thyroid lobectomy did not increase the incidence of postoperative RLN palsy ($P = 0.051$). The risk of RLN palsy from surgery for a malignant neoplasm is not significantly different ($P = 0.215$) from surgery for benign disease.

Length of Hospital Stay

Patients with benign thyroid disease had a median hospital stay of 3 days (range, 1 to 23 days). In the group with malignant thyroid disease, neck dissection prolonged the median hospital stay considerably to 16 days (range, 6 to 64 days) when compared to the median hospital stay of 4.5 days for the group with tracheo-oesophageal groove clearance only (range, 2 to 9 days).

Discussion

FNAC

In the diagnostic work-up of a thyroid nodule, FNAC is safe, simple and cost-effective. The reported sensitivity, specificity and diagnostic accuracy of FNAC for a thyroid malignancy ranged from 86% to 94%, 60% to 97% and 94% to 98%, respectively.⁷⁻¹⁰ The sensitivity, specificity, and accuracy of FNAC in this series were 60%, 100% and

TABLE III: INCIDENCE OF RECURRENT LARYNGEAL NERVE PALSY ACCORDING TO THE EXTENT OF SURGERY

Extent of surgery	No. of patients (n = 87)		Total
	RLN palsy present	RLN palsy absent	
Group I (with TEG clearance)			
Total thyroidectomy with TEG clearance	4	10	14
Subtotal	4	10	14
Group II (without TEG clearance)			
Total thyroidectomy	1	9	10
Completion total thyroidectomy	—	2	2
Near total thyroidectomy	—	4	4
Unilateral thyroid lobectomy	5	52	57
Subtotal	6	67	73
Total	10	77	87

RLN: recurrent laryngeal nerve; TEG: tracheo-oesophageal groove
Fisher's exact test = 0.051

TABLE IV: INCIDENCE OF RECURRENT LARYNGEAL NERVE PALSY ACCORDING TO THE HISTOPATHOLOGIC CHARACTERISTICS

Histopathologic diagnosis	No. of patients (n = 87)		Total
	RLN palsy present	RLN palsy absent	
Group I (malignant)			
Papillary carcinoma	4	15	19
Subtotal	4	15	19
Group II (benign)			
Nodular hyperplasia	4	32	36
Simple cyst	2	1	3
Others	—	29	29
Subtotal	6	62	68
Total	10	77	87

RLN: recurrent laryngeal nerve
Fisher's exact test = 0.215

77%, respectively.

FNAC remains an operator-interpreter dependant procedure. Poor cellular yield may result from inexperience or poor operator technique. Errors in diagnosis may occur when making a diagnosis on the basis of inadequate cytologic material. Furthermore, the deficiency in the cytologic distinction between malignant and benign follicular neoplasms is well known. Our FNAC false negative (7%) and unsatisfactory specimen (13%) rates were high. In an effort to reduce the false-negative diagnoses and inadequate yield of cytologic material, our revised practice is to acquire a minimum of two aspirates from different sites of each nodule and have a cytology technician screen each FNAC specimen for adequate clusters of cells.

The probability of malignancy in a thyroid lesion demonstrated by FNAC to be a follicular neoplasm is approximately 20%.¹¹ In an effort to reduce unnecessary surgery, several authors have prospectively evaluated patients with follicular neoplasms present on FNAC to identify the clinical features associated with an increased risk of thyroid malignancy. Integrating multiple features by means of Bayesian analysis, the probability of malignancy in a male, with a solitary nodule, greater than 4 cm, diagnosed as a follicular neoplasm on FNAC approaches 77%, compared with a risk of only 3% in females with small nodules.¹² Likewise, with a cytologic diagnosis of follicular neoplasm, a solitary nodule, hard to palpation, hypodense by thyroid ultrasonography, or the factors in combination, predict for an increased risk of malignancy.¹³

Intraoperative Frozen Section Examination

Frozen section examination has an integral role in our surgical management of thyroid nodules. Its clinical utility is as an intraoperative diagnostic adjunct, especially when the FNAC report identifies a follicular lesion¹⁴ or is inconclusive. Nine (13%) patients benefited from frozen section. This figure includes 2 of 20 (10%) patients who had FNAC reported as a follicular lesion. In each patient, papillary carcinoma was correctly diagnosed and one-stage total thyroidectomy performed.

The reported sensitivity, specificity and diagnostic accuracy of frozen sections for a thyroid malignancy ranged from 86% to 93%, 96% to 100% and 94% to 97%, respectively.^{7,9,15} In our series, the sensitivity, specificity, and diagnostic accuracy of frozen sections were 82%, 100% and 96%, respectively.

Notwithstanding, frozen section has its pitfalls. There were 2 (3%) false-negative results in our series. Each of these patients required second-stage completion total thyroidectomy. The limited sampling inherent to frozen section may overlook an invasive tumour focus. This is

especially so in follicular thyroid carcinoma where the diagnosis hinges on vascular or capsular invasion which may require multiple sections to appreciate. Moreover, the cellular distortion and artifact induced by tissue freezing may mask subtle morphologic atypia that characterises papillary thyroid carcinoma. Several investigators have suggested that frozen section is unreliable as a routine diagnostic adjunct to distinguish between a benign and malignant tumour, correctly identifying a malignancy in only 3.4% and failing to resolve the nature of a follicular neoplasm in the remainder of their patients.^{11,16} For a significant proportion (45%) of our patients with follicular neoplasms of the thyroid, frozen section indeed failed to resolve the nature of the follicular lesion—all later proved benign on histopathology. Nevertheless, frozen section has served our practice well by correctly identifying all patients with papillary carcinoma within the subgroup diagnosed with a follicular lesion on FNAC. We strongly advocate that surgeons examine the fresh gross specimen and selectively direct the use of frozen section in suspicious lesions.

Hypocalcaemia and Hypoparathyroidism

Transient postoperative hypocalcaemia is relatively common following thyroidectomy with a reported incidence ranging from 6.9% to 46%.^{17,18} Permanent hypocalcaemia is rare (0.2% to 1.9%) but may pose significant problems. In this series, the incidence rates of transient and permanent hypocalcaemia were 43.7% and 0%, respectively.

The cause of hypocalcaemia after thyroidectomy is widely accepted to be due to hypoparathyroidism. Hypoparathyroidism after thyroidectomy has been attributed to damage, devascularisation or inadvertent removal of the parathyroid glands at operation.

Nodal dissection after total thyroidectomy for thyroid malignancy increases the incidence of postoperative hypocalcaemia significantly.¹⁹ Although the number of parathyroid glands preserved could not predict for postoperative hypocalcaemia, these glands should be identified and preserved *in situ* whenever possible. The trend of early postoperative serum calcium has been investigated to predict for postoperative hypocalcaemia. A steep negative gradient of the curve (-1.4% change/h), plotted with 2 postoperative serum calcium levels within the first 8 hours, predicts a higher probability of hypocalcaemia. This allows for early identification of patients who will require monitoring, and early discharge for those thought likely to remain normocalcaemic.²⁰ It has been shown that despite prolonged calcium administration, serum calcium concentration remained significantly lower during the first 6 months in patients with fewer parathyroid glands.²¹ Autotransplantation should be attempted for

inadvertently removed or devascularised parathyroid glands in an attempt to avert postoperative hypoparathyroidism.²²

RLN Palsy

RLN injury, a complication of thyroid surgery, disturbs the normal laryngeal functions of voicing and respiration. The reported incidence of permanent recurrent nerve palsy varies widely from 0.5% to 4.7% after thyroid surgery.^{19,23} Postoperative RLN palsies generally have an excellent recovery rate with reported rates of 40% to 93%.²⁴⁻²⁶ Our permanent RLN palsy rate of 1.1% and RLN palsy recovery rate of 90%, based on the number of patients, are consistent with other reported series. With the routine identification and cautious dissection of the RLN during thyroid lobectomy and nodal clearance, the risk of postoperative RLN palsy is minimal; moreover, the recovery potential of unexpected RLN palsy remains excellent.

Conclusion

The estimation of the risk of malignancy in a thyroid nodule is crucial in determining the optimal management for an individual patient. The combination of clinical examination and FNAC is essential in the selection of patients for surgery. Until we improve the sensitivity and diagnostic accuracy of FNAC, frozen section analysis remains a practical intraoperative diagnostic adjunct.

The cornerstone of safe and effective thyroid surgery is training and understanding the physiology, the surgical anatomy and its variations, and pathology of the thyroid gland. Safe surgery requires a specific operative plan, progressing in a series of logical, orderly, anatomically based steps. The current environment of cost containment, and evolution of outpatient and short-stay thyroidectomy emphasises the need to avoid complications by utilising meticulous surgical technique. With the appropriate training, thyroid surgery for malignancy may be undertaken by experienced surgeons, and closely supervised residents, with minimal risk of damage to the RLNs and the parathyroid glands.

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