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Comparison of the Complications of Subtotal, Near Total and Total Thyroidectomy in the Surgical Management of Multinodular Goitre

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Abstract. Purpose of the study is to compare complication rates of bilateral subtotal (BST), near total (NTT) and total thyroidectomy (TT) in a cohort of patients undergoing surgery for benign multinodular goitre (MNG). Seven hundred and fifty patients undergoing surgery for MNG were studied with a median follow-up of 53 months (range 18–102). There was no operative mortality in this group and no patients required urgent re-exploration for haematoma. After BST 14 patients (14/170 – 8.2%) developed transient hypocalcaemia and 4 patients (4/170 – 2.4%) had transient and one permanent (1/170 – 0.6%) recurrent laryngeal nevre (RLN) palsy. In NTT group 39 patients (39/320 – 12.2%) developed transient hypocalcaemia and 2 patients (0.6%) transient voice disturbances. None of the patients in this group experienced permanent complications. However, in TT group 78 patients had (78/260 – 30%) transient hypocalcaemia whereas only one patient (1/260 – 0.4%) suffered permanent hypoparathyroidism and 5 patients (5/260 – 1.9%) had temporary RLN injury but none of them remained permanent. There are only 2 (2/170 – 1.2%) recurrences and those patients are in BST group. All of the patients in BST group required at least 100 μg of thyroxine supplementation following the operation. These results demonstrate low permanent complication rates following thyroid surgery. Although the incidence of transient hypoparathyroidism increases with the extent of the resection, permanent complication rates are similar for all three surgical procedures. Even with short follow-up, there is a risk of recurrence with BST and therefore NTT or TT may be the operation of choice for MNG.

Key words: Thyroidectomy, Goitre nodular, Multinodular goitre, Complications

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SURGICAL resection is the treatment of choice for the majority of patients with benign multinodular goitre (MNG). Current indications for surgery are compression-induced symptoms, suspected malignancy, hyperthyroidism and cosmesis [1–4]. Surgical options for the management of MNG include bilateral subtotal thyroidectomy (BST), near total thyroidectomy (NTT – total lobectomy on the dominant side and a subtotal lobectomy on the contra lateral side) and total thyroidectomy (TT). Although there is debate about the optimal surgical procedure for these patients the choice of surgical technique must take into account the potential benefits and complications of each procedure.

The main reason for performing BST is a presumed lower incidence of post-operative complications, including recurrent laryngeal nerve (RLN) palsy and hypoparathyroidism, and an attempt to achieve post-operative euthyroid status [5]. However, there is a risk that the goitre will recur (9–43%) and an increased surgical morbidity during re-operation [6–8]. Furthermore, a number of patients treated by sub-total thyroidectomy will still require thyroxine replacement

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following surgery.

There are increasing numbers of publications recommending TT for bilateral MNG [9–17]. The authors who favour TT state that this operation has low complication rates in the hands of experienced thyroid surgeons [18, 19] and has an incidence of iatrogenic injuries that is similar to a subtotal procedure [20, 21].

The aim of this study was to compare the complication rates of BST, NTT and TT, in a cohort of patients undergoing thyroid surgery for MNG in the hands of three experienced endocrine surgeons. A search of the literature in English language published between 1970–2002 was performed using both medical subject headings (MeSH) and free-text searching of the Medline database with cross-referencing from key articles. Search terms utilised were 'thyroidectomy', 'goitre, nodular', 'multinodular goitre', and 'complications'.

Materials and Methods

The hospital records of 750 patients who underwent thyroid surgery, for presumed MNG, at the Ankara University Ibni Sina Hospital between January 1994 and December 2000 were reviewed. Additional information was retrieved from their private database collated by the two surgeons (*SK & SA*). All operations were performed or supervised by three consultant surgeons (*SO & SK & SA*) using a similar surgical technique. Only patients with a minimum follow up of 18 months were included. Indications for surgery in this study group are enlarging goiters with compression symptoms, suspected malignancy (concern about fine needle aspiration cytology) and toxic nodular goitre.

Thyroidectomy technique

Total thyroidectomy was performed by extra capsular dissection to remove both thyroid and pyramidal lobes. Several techniques were reported for identifying the RLN or monitoring its function and preserving the parathyroid glands. We prefer to identify the nerve just caudal to the point where it crosses the inferior thyroid artery and to dissect it in both directions: caudally to the mediastinum and cranially to the cricothyroid junction. After the thyroid gland is mobilized medially, the connective tissue on the tracheaesophageal space is dissected to identify the nerve. At this step we use a saline jet spray. The saline spray cleans the area and helps spread the fibers of the connective tissue, leaving all nerves and vessels, which can then be easily identified. Most important is that the saline spray also causes thickening of the nerve sheath. If the nerve bifurcates in branches, which is not a rare condition, all of the branches are identified with use of the saline spray. Also for parathyroid gland identification the saline jet spray is more effective than pouring saline because the area is not only washed but also wiped. All vessels were ligated close to the thyroid gland especially the branches of the inferior thyroid artery. Parathyroid glands and RLNs were also observed and preserved in a similar way while performing BST or NTT. In the NTT group, lobectomy was performed on the larger or more nodular thyroid lobe or including the dominant nodule with contralateral subtotal resection leaving an average of 1–2 g of thyroid tissue. Approximately 4–6 g of thyroid tissue was left after BST. Non-viable parathyroid glands were auto transplanted immediately.

In the early years of this patient cohort BST was the operation of choice especially in symptomatic patients with enlarging diffuse or noduler goitre without a dominant nodule or suspected malignancy. As the experience increased with total procedures, NTT became the mostly prefered operation in such cases as well as in patients who have dominant nodules. Another intraoperatively decided indication for NTT was a possible injury to RLN or parathyroid glands on one side. However, TT was performed when there was bilateral involvement of the thyroid gland parenchyma posterior to middle thyroid vein and when there were doubts on frozen section analysis.

Permanent injury to the RLN was defined as palsy of the vocal cord, diagnosed by an otolaryngologist using either indirect laryngoscopy or videolaryngostroboscopy, which lasted for more than six months postoperatively. A temporary palsy recovered within six months. Temporary hypoparathyroidism was defined as a fall in corrected serum calcium concentration below 8 mg/dL, and/or the need for calcium supplementation. Permanent hypoparathyroidism was defined as the need for oral vitamin D and/or calcium supplements six months following surgery to maintain a normal serum calcium concentration.

A recurrence of MNG was diagnosed when physical examination or follow-up ultrasound scanning showed nodular involvement or enlargement of the residual thyroid remnant. Serum calcium concentration was measured preoperatively in every patient and then each

day post-operatively. All patients were discharged on L-thyroxine 100 μg daily. The patients who had a normal postoperative course were seen 6 to 8 weeks following surgery and the dose of L-thyroxine was subsequently adjusted according to the TSH level.

Differences between the groups were analysed using non-parametric tests (Kruskal-Wallis and Mann-Whitney U test) and one-way ANOVA. Statistical analysis was preformed using SPSS® (SPSS, Chicago, IL, USA) software and $p<0.05$ was considered statistically significant.

Results

The demographic features of the patients, post-operative complications, mortality and recurrence rates are presented in Table 1. There is no operative mortality and no patient required urgent re-exploration for haematoma. Haematoma occurred in only one patient who had TT (0.4% – 1/260) and resolved spontaneously without drainage. Postoperative wound infection occurred in only one patient in the BST group (0.6% – 1/170) and after surgical drainage the wound was resutured several days later when the infection had resolved. The median post-operative hospital stay was 1.3 days (range 1–8). Post-operative stay was similar for all groups: TT 1.4 days (range 1–8), NTT 1.3 days (range 1–3) and BST 1.3 days (range 1–8), $p>0.05$. Median follow-up was 53 months (range 18–102).

Only one patient, who was treated by TT, developed permanent hypoparathyroidism (0.4% – 1/260) and remains on calcium and vitamin D supplementation. The incidence of temporary hypoparathyroidism was much higher at 30% (78/260), 12.2% (39/320) and 8.2% (14/170) of patients treated by TT, NTT and, BST respectively. One-way ANOVA and *post hoc* tests showed significant difference between groups TT and NTT, as well as TT and BST ($p<0.01$), but not between NTT and BST ($p>0.05$). None of the patients who have autotransplanted parathyroid glands intra-operatively suffered from hypocalcemia after the operation.

Only one patient, treated by BST, developed a permanent RLN injury, (0.6% – 1/170). The incidence of temporary RLN palsy was found to be 1.9% (5/260) in TT, 0.6% (2/320) in NTT and 2.4% (4/170) in BST patients ($p>0.05$). No patient in this study group developed a bilateral RLN palsy.

The final histopathology results following surgery are shown in Table 2. When this revealed incidental micropapillary or minimal invasive follicular carci-

Table 1. Demographic features with complication and recurrence rate of each operative procedure and follow-ups

	Total thyroidectomy (TT)	Near total thyroidectomy (NTT)	Bilateral subtotal thyroidectomy (BST)
Number of patients	260	320	170
Mean age	46.7	43.1	41.2
Temporary RLN palsy	5 (1.9%)	2 (0.6%)	4 (2.4%)
Permanent RLN palsy	—	—	1 (0.6%)
Temporary hypoparathyroidism	78 (30%)	39 (12.2%)	14 (8.2%)
Permanent hypoparathyroidism	1 (0.4%)	—	—
Recurrence of goitre	—	—	2 (1.2%)
Mortality rate	—	—	—
Haematoma	1 (0.4%)	—	—
Wound infection	—	—	1 (0.6%)
Follow-up (months)	51 (range 22–96)	50 (range 25–90)	61 (range 18–102)

Table 2. Final histopathological results of coexistence of other diseases in multinodular goitre

	Total thyroidectomy (TT)	Near total thyroidectomy (NTT)	Bilateral subtotal thyroidectomy (BST)
MNG + Malignancy	34	16	8
MNG + Adenoma	9	5	2
MNG + Thyroiditis	31	15	13
Pure MNG	186	284	147

MNG: Multinodular goitre

noma, the patients were followed-up, regardless of which surgical procedure had been performed. Three patients, treated initially by BST, required further surgery for malignant disease following histopathological examination of the resected specimen. All of them were papillary carcinomas which were at least 1 cm in diameter. As soon as the final histopathological reports were obtained, second operations were performed in two weeks time after the initial operation. These patients all had a total lobectomy on the affected side, with no contra lateral surgery, and subsequent radioiodine therapy.

Two patients in the BST group suffered recurrence (1.2% – 2/170) diagnosed 24 and 30 months post-operatively by a combination of clinical examination and ultrasonography. Following confirmation of benign disease on fine needle aspiration cytology, they were treated conservatively by increasing the thyroxine dose from 100 μg to 150 μg daily.

Following surgery all patients required a minimum of 100 μg L-thyroxine daily. The requirement to prescribe a dose greater than 100 μg increased with the extent of resection with 69.1% in the BST group, 88.5% in the NTT group and 92% in the TT group.

Discussion

In the presence of MNG, there are currently several options for the type of surgery that can be offered to these patients. In recent years there has been a change in the surgical treatment of multinodular thyroid disease, with an increasing number of surgeons performing total or near-total thyroidectomy. Following a decision to operate for MNG the advantages and disadvantages of each procedure should be considered and discussed with the patient to select the most appropriate procedure.

In several regions of Turkey, goitre is still an endemic disease and MNG patients constitute a large part of the workload of both general and endocrine surgeons. Since the clinical and pathophysiological evidence suggests that MNG affects the entire gland [22], any surgery that leaves potentially abnormal thyroid tissue in situ carries a risk of recurrent disease.

The popularity of BST for MNG is decreasing with time. It has the disadvantage of high recurrence rates and carries the risk for increased surgical morbidity during the course of re-operation [4, 9, 20, 23]. The incidence of recurrence after subtotal thyroidectomy varies in different studies and may be as high as 23% [8, 12, 24]. The recurrence rate following BST is largely dependent on the length of follow-up, and has been reported as 42% in one study with thirty-year follow-up [23]. Two patients (1.2% – 2/170) in this study experienced recurrent disease following BST, one of them 2 years and the other 2.5 years after the initial operations but the follow-up period is too short to make any comparison between BST, NTT and TT.

Re-operation for recurrent disease carries a significant risk of damage to both RLNs and the parathyroid glands and during completion thyroidectomy there is a ten-fold increase in iatrogenic injuries [8]. As a general rule the risk of complications increases with the number of re-operations performed [8, 10]. The re-operation rate in our study is 0.4% (3/750). All three patients initially treated by BST underwent completion thyroidectomy for malignancy with no subsequent complication.

One potential reason for performing BST is the maintenance of euthyroid status without thyroxine replacement. It has been well documented, however, that to leave a small thyroid remnant *in situ* will not prevent the onset of hypothyroidism [12, 16, 22]. This finding has been confirmed in our study with 100% of all patients treated by BST, for benign MNG, requiring at least 100 μg L-thyroxine daily. Furthermore, in the presence of unrecognised malignancy, BST may represent inadequate surgery [25]. The incidence of occult malignancy is generally thought to be 7%–10% [12, 15]. The tumours are usually well-differentiated cancers and are often either papillary or follicular in nature [2, 26]. In this study the overall occult malignancy rate is 7.7% (58/750) and was noted to be lower in the BST group (4.7% – 8/170) because of the selection criteria of NTT or TT for nodules suspicious of malignancy. Moreover, malignant transformation in the thyroid remnant after subtotal resection ranges from 4% to 17% [2, 27].

The potential benefits of TT include adequate removal of the disease, prevention of recurrence, and avoidance of the need for completion surgery in the presence of occult malignancy [12, 15]. The only real argument against TT is the potential increase in the rate of complications.

There is no doubt that a well-trained endocrine surgeon can achieve extremely low complication rates, especially when using the technique of capsular dissec-

tion, staying close to the thyroid gland, and preserving the blood supply to the parathyroid glands, along with identification and preservation of the recurrent laryngeal nerve [28]. In addition further studies have demonstrated that surgical residents can perform TT just as safely as experienced endocrine surgeons, provided they have appropriate supervision [13, 29]. As a result the number of patients with MNG treated by TT is increasing and now exceeds 80% [10].

The three main complications following thyroid surgery include RLN palsy, hypoparathyroidism and postoperative haemorrhage. There were no patients in this study who required re-operation for haematoma. The reason for this may be one by one ligation of the each branch of the vessels of the superior and inferior pole close to the thyroid gland. In experienced hands the incidence of permanent RLN palsy ranges from 0–0.7% following TT [10] and from 0–1.3% following BST [30]. It has long been recognised that failure to recognise the RLN increases the risk of damaging it [31]. The authors (*SK & SA*) are performing the described technique since 1992 for identifying the RLNs and the parathyroid glands [32]. The permanent RLN palsy rate was low in all three groups in keeping with previous series by experienced surgeons and within current guidelines (permanent vocal cord palsy rate <1%) issued by the British Association of Endocrine Surgeons [33]. There was no significant difference between these groups.

Every effort should be made to preserve parathyroid glands with their own blood supply however, this may not be sufficient to prevent the occurrence of transient hypoparathyroidism and transient post-thyroidectomy hypocalcemia, secondary to hypoparathyroidism, is common [34, 35]. Delbridge *et al.* [12] state that transient hypoparathyroidism should be an accepted outcome of bilateral thyroid surgery rather than a complication. It is noted that the degree and duration of hypocalcemia increase with the extent of thyroid surgery [36]. Our results concur with the literature with an incidence of temporary hypoparathyroidism increased with the extent of surgery (Table 1). There was, however, no difference in the rates of permanent hypoparathyroidism between the three groups (BST 0%; NTT 0%; TT 0.4%).

A number of patients in this series had near-total thyroidectomy. This procedure offers an alternative to TT by performing a total lobectomy on the dominant side and a subtotal lobectomy on the contra lateral side, leaving behind nearly 1–2 g of thyroid tissue on the less affected side. It has been suggested that this procedure combines the advantages of TT (no recurrences) with those of subtotal thyroidectomy (low incidence of transient and permanent hypoparathyroidism). However, Pappalardo *et al.* [37] suggested that no advantages be offered by this procedure, when compared with TT, with the possible exception of a lower incidence of temporary hypoparathyroidism, which can easily be managed medically. Despite this we believe that there may be specific indications for this procedure especially when there is doubt about the integrity of RLN on the lobectomy side or when a patient may be at increased risk of hypoparathyroidism during the operation. In our series 42.6% (320/750) of cases had NTT as the initial operation for benign MNG. This was performed to remove the diseased thyroid gland, with a low recurrence rate, and to attempt to reduce the incidence of hypoparathyroidism and RLN palsy. In addition a small thyroid remnant renders it accessible to ^{131}I ablation if an occult cancer is found in the specimen and avoids re-operation for completion thyroidectomy. In this series there was a transition from NTT to TT as the surgeons realised that by careful dissection and appropriate surgical technique TT could be performed as safely as NTT. Although there is no recurrence in the NTT group, our follow-up period is too short to compare with TT at this stage.

It is known that retrospective reviews often fail to detect all cases and the retrospective design of the study may prevent any firm conclusion on the incidence of complications. However, considering the large number of patients included in this study, our results show that experienced endocrine surgeons performing total or near total thyroidectomy for benign MNG can achieve low permanent complication rates. We conclude that the operative skills and experience determine the complication rates rather than the type of operative procedure.

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