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The anatomical characteristics of the pyramidal lobe of the thyroid gland: a study on 180 patients

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ABSTRACT

Background

The pyramidal lobe is the most encountered anatomical variation the thyroid gland. The existence of this lobe can compromise the completeness of total thyroidectomy, which in turn hinders the effective treatment of malignant and autoimmune thyroid diseases. The purpose of this study is to analyze the anatomical characteristics of the thyroid's gland pyramidal lobe. Knowledge of these traits can help avoid surgical pitfalls.

Materials and Methods

The features of the pyramidal lobe were studied retrospectively in 180 total thyroidectomy specimens that were collected between 01/01/2015 and 31/03/2018

Results

The pyramidal lobe was identified in 48.1% of the patients with no significant difference between genders. It was documented in the histopathologic report in 48.8% of the patients but only 33.3% (14 cases) had lesions in it, with a single case of malignancy. The lobe originated from the middle line in 41.8% of the patients, from the left side of the middle line in 27.9% of the patients and from the right side of the middle line in another 27.9%. The pyramidal lobe's length was 3.26 cm.

Conclusions

The pyramidal lobe of the thyroid gland is an anatomical variation that is present at almost 50% of the cases and when existing, complexes the completeness of total thyroidectomy. It is the most common cause of incomplete excision and most common site of recurrence. Therefore, knowledge of its anatomical traits, correct preoperative evaluation and application of proper tips and tricks is essential in achieving a true total thyroidectomy.

Key words: thyroidectomy–endocrine surgical procedures–thyroid gland–surgical procedures minimally invasive

1 INTRODUCTION

The thyroid gland is the first endocrine gland that is developed in the fetus and originates from a thickening of the endoderm of the primordial pharynx [1, 2]. This epithelial development forms a small diverticulum, the primordial thyroid gland. As the fetus and the tongue grow, the developing gland moves downwards, in front of the pharyngeal bowel. The gland takes the form of a bilobal diverticulum as it passes in front of the developing hyoid bone and the laryngeal cartilages. During its migration, the thyroid gland remains connected to the tongue with the thyroidoglossal

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duct [1, 2]. The point of the original development is later indicated by the foramen cecum of the tongue. The final place of the gland is in the lower part of the anterior surface of the cervix, in front of the 2^{nd}, 3^{rd} and 4^{th} semi-cartilage of the trachea, between the fifth cervical and the first thoracic vertebrae [1, 2]. The gland weighs 25-30 g and its shape looks like the letter *H* or *U,* since it consists of two lateral lobes and the connecting isthmus. In 50% of the cases a pyramidal lobe is also present, which originates from the isthmus and is pointed towards the hyoid bone [1, 2].

The pyramidal lobe is a common example of an anatomical variation of the thyroid gland which can interfere with the completeness of a total thyroidectomy. This is extremely important when the procedure is carried out for a malignant or autoimmune disease. The presence of residual tissue after the resection of the gland can complicate the proper postoperative treatment and follow-up of the patients. If the pyramidal lobe is not removed during total thyroidectomy, the postoperative hypertrophy can lead to a recurrence of the disease in the form of a nodule in the middle line, even many years after the first procedure. The frequency of residual pyramidal lobe is up to 23% in total thyroidectomies that are carried out for benign diseases [3]. In patients with well differentiated thyroid cancer residual thyroid tissue is found in 30.5%-46% after the administration of radioactive iodine [3].

The present article aims to demonstrate and analyze the anatomical, surgical and histopathological characteristics of the pyramidal lobe based on 180 total thyroidectomy specimens.

2 MATERIALS AND METHODS

This article is a retrospective presentation of prospectively collected data of patients that were subjected to total thyroidectomy from 1/1/2015 to 3/31/2018. 180 patients were included in the study. The recorded data included the demographic characteristics of the patients, the date of the operation, the preoperative laboratory and imaging studies, the postoperative laboratory studies, the initial and final diagnosis according to the International System of Classification of Diseases ICD-10, the histopathological report and the photograph of the specimen.

The characteristics of the pyramidal lobe that were studied were its presence, its length, its point of origin in relation to the middle line, its description in the histopathological report and the presence of specific histopathological lesions in it. The length and the location of the pyramidal lobe were evaluated after the thyroid gland was resected. The origin of the lobe was defined as “from the middle line”, “from the right side of the middle line” and “from the left side of the middle line”. The lobe was examined histopathologically in order to assess if it was affected by the general disease of the rest of the gland and if it contained benign or malignant lesions. The data was recorded using Microsoft Excel software, version 2007.

The statistical analysis was performed using SPSS software, version 24.0. The level of statistical significance was defined as $p<0.05$. The data is presented as mean value ± standard deviation. The sample’s normality was checked using the Shapiro-Wilk test, since its size was N=180. The binominal control was used to assess the statistical significance of a deviation of a calculated mean value from an expected mean value. The chi-square test was used to define if there was statistically significant difference between the expected and the calculated frequencies in two or more categories. The z-test was used to compare the mean value of a series of values with a given constant value. Finally, the Student’s t-test was used to compare the mean values of two continuous variables.

3 RESULTS

Among the 180 participants of the study, 54 of them (30%) were male and 126 (70%) were female. The patients’ age ranged from 16 to 89 years with a mean value of 51.2 years (SD 14.3 years).

Among the 180 participants, the pyramidal lobe was recognized macroscopically in 86 of them (47.8±3.7%), while in the rest 94 (52.2±3.7%) it was not. Among the 86 cases of macroscopically recognized pyramidal lobes, only 42 (48.8±5.4%) of them were described in the histopathological report, while the rest 44 (51.2±5.4%) were not. Among the 42 cases of described pyramidal lobes, 14 (33.3±7.3%) of them had certain histopathological lesions, while the rest 28 (66.7±7.3%) did not. Out of the 86 recognized pyramidal lobes, 25 (27.9±4.8%) originated from the right side of the middle line, 36 (41.8±5.3%) originated from the middle line and the rest 25 (27.9±4.8%) originated from the left side of the middle line. Among the 14 pyramidal lobes that had specific lesions described in the histopathological report, 13 cases of benign multinodular goiter lesions were discovered in the lobe and only case of papillary thyroid carcinoma. In total, there were 96 cases of benign multinodular goiter, 51 cases of papillary thyroid cancer, 14 cases of follicular adenoma, 3 cases of follicular carcinoma, 4 cases of myeloid carcinoma, 10 cases of Hashimoto thyroiditis and 2 cases of Grave’s disease. As a result, the overall percentage of papillary thyroid cancer in the pyramidal lobe among all cases of papillary thyroid cancer was 1.9±1.9% (1/51 cases). The length of the pyramidal lobe was 3.26±1.56 cm (1.0-8.5 cm).

4 DISCUSSION

According to our research and taking into account the incidence of a present of pyramidal lobe in the international literature (50%), the results of binominal control revealed that there was no statistically significant difference between the patients of our specimen where the pyramidal lobe was

recognized and the general population (p=0.602). In addition, no statistically significant difference between male and female patients with a present pyramidal lobe was found (p=0.195). Moreover, no significant difference was found between patients where the pyramidal lobe was described in the histopathological report and those where it was not (p=0.414). Nonetheless, there was statistically significant difference between patients where specific histopathological lesions in the pyramidal lobe where found and those were, they were not (p=0.016). In our study the pyramidal lobe originated from the middle line in 41.8% of the cases, from the right side of the middle line in 27.9% and from the left side in 27.9% as well. The result of the z-test revealed that there is no statistically significant difference among the different points of origin (p=0.058)

In the international literature there is great heterogeneity concerning the presence of the pyramidal lobe that varies from 12% to 66% [4]. This heterogeneity can be attributed to gender, age and nationality of the patients, geographical factors, methodology of the study and whether it was conducted on surgical or cadaveric specimens.

In a retrospective study of 103 surgical specimens from patients who were operated for thyroid cancer Irawati N. et al report the presence of the pyramidal lobe in 36.89% of patients, with greater frequency among males. The origin of the pyramidal lobe is most commonly found to the left of the middle line, while mean length was 18.0±12.4 mm. Malignant lesions in the pyramidal lobe were reported in 10.53% of the patients, all of them being cases of well-differentiated thyroid cancer [4]. In a prospective study of 342 patients, Kovacic et al identified the pyramidal lobe in 52.3% of the patients with the most usual point of origin being the middle line and the left side of it, while no statistical difference between genders was discovered [5]. The length of the lobe varied between 1.3 cm and 4.7 cm with a mean value of 2.3 cm. In a study of 80 cadaveric specimens, Rajkonwar AJ et al identified the pyramidal lobe in 38.75% of the patients with a greater frequency in males. The point of origin of the lobe was on the left of the middle line in 74.2%, while no case of origin from the right side was reported [6]. In another study of 58 cadaveric specimens the lobe was identified in 55.2% of the specimens with no significant difference among the different points of origin [7]. In this study the mean length of the lobe was 22.6±10.5 mm. In another prospective study by Gurleyik E. et al in 166 patients that were subjected to total thyroidectomy, the pyramidal lobe was identified in 65.75% with no difference between males and females. In the majority of the cases (52.3%) the pyramidal lobe originated from the middle line and its length varied from 5 mm to 59 mm (mean length 22.7 mm) [3].

In a study by Takanashi Y. et al that was conducted in 70 fetal specimens aged between 6 and 15 weeks the pyramidal lobe was identified in 35.9% of the fetuses with greater prevalence in later stages of development [8]. In another prospective study based on ultrasound results of 416 patients, the pyramidal lobe was discovered in 21% of them. 51% of them originated from the right side of the middle line, 46% of them from the left side and 2% of them originated from the middle line. In this study one case of double pyramidal lobe is reported. Its length ranged between 9 mm to 39 mm with a mean value of 19 mm [9]. In a retrospective study that was based on the scintigraphic findings of 866 patients, the pyramidal lobe was identified in 18% of the cases. 81% of these patients were female. In this study, the pyramidal lobe originated from the left lobe in 48% of the cases, from the right lobe in 40% and from the isthmus in 12% of the cases [10]. In a large multicenter study of 2200 patients, the features of the pyramidal lobe were assessed according to the results of cervical computed tomography. In this study the pyramidal lobe was identified in 44.6% of the cases, originating from the left of the middle line in 43.4% of the cases, from the right in 28.0% of the cases and from the middle line in 25.7% of the cases, while a bilateral point of origin was reported in 2.9% of the cases [11]. Furthermore, 90 cases of a separated pyramidal lobe from the rest of the thyroid gland were reported. The median length of the lobe was 20.76±10.87 mm. In another retrospective study that was based on computed tomography findings from 327 patients the pyramidal lobe was discovered in 41.3% of the patients. In 12.6% of these cases the lobe was completely separated from the rest of the gland. Its point of origin was more frequently from the left side of the middle line (54.1%), while two case of bilateral origin were reported [12]. The mean length of the lobe was 25.0 mm.

In a prospective study of 100 surgical specimens of subtotal and total thyroidectomies the lobe was identified in 61% of the patients with a higher frequency among females (61.96%) and among patients over 50 years old (67.3%). In this study the pyramidal lobe originated more commonly from the middle line (48.18%) and its mean length was 20.13 mm [13]. In another study of 604 surgical specimens, the pyramidal lobe was identified in 12% of the patients with preoperative identification in only 50% of them. In 77% of these cases the pyramidal lobe had benign lesion in the context of multinodular goiter, while in 1.3% of the cases a papillary thyroid carcinoma was identified. The origin of the pyramidal lobe was found to the left of the middle line in 96% of the cases [14]. In another study of 58 cadaveric specimens the pyramidal lobe was identified in 55% of the specimens, more commonly among men. The mean length of the lobe was 14 mm in males and 29 mm in females. In the majority of the cases (16/32) the pyramidal lobe originated to the left of the middle line [15].

The pyramidal lobe can be considered a congenital abnormality in the development of the thyroid gland or an anatomical variation or a normal part of the gland [7]. This lobe is related to the distal part of the thyroidoglossal duct and to the levator muscle of the thyroid gland. As the lobe extends to the hyoid bone, it is attached to it by a fibrous cord. Functional thyroid tissue might be present in this cord and it is not usually excised during thyroidectomy [16]. The pyramidal lobe is recognized preoperatively only in 50% of the cases either using ultrasound or Tc-99m scintigraphy scan [7]. In cases where the pyramidal lobe is not completely removed during the operation, it can compromise the result of the postoperative radioactive iodine therapy as well as result in recurrence of an autoimmune or malignant disease.

The rate of residual thyroid tissue in the area of the pyramidal lobe reaches up to 23% in cases of total thyroidectomies that are carried out for benign diseases [3]. The percentage of functional residual thyroid tissue in postoperative exams of patients who have been subjected to total thyroidectomy is reported between 52%-93%. This tissue appears in the anatomical region of the pyramidal lobe in 46.1% of the cases [17]. This percentage is in accordance to anatomical studies on cadavers the report the presence of indistinguishable pyramidal lobe in up to 55% of the cases. The residual thyroidectomy of this remnant is achieved through radioiodine ablation [16].

The main pitafall in thyroid surgery regarding the pyramidal lobe is its incomplete excision, which is extremely important in cases of malignant or autoimmune diseases. Knowledge of the anatomical variations of the pyramidal lobe and its preoperative recognition combined by applying useful tips and tricks can facilitate a truly total thyroidectomy [18]. This is highly significant nowadays, in the era of minimal access thyroid surgery, where there are many different techniques used. The use of accessory tools such as headlights and magnifying loops always helps the surgeon identify anatomical structures more easily .

In cases where the procedure is carried through a mini-incision (mini-incision thyroidectomy) the key step t completely remove the pyramidal lobe is placing the incision higher in the neck and create a skin flap up to the thyroid notch or remove part of the subcutaneous tissue in order to create a long enough tunnel. In partly endoscopic-partly open procedures, such as minimally invasive video-assisted thyroidectomy (MIVAT), robotic facelift thyroidectomy and transaxillary gasless robotic thyroidectomy the key is to recognize the pyramidal lobe early and diving the isthmus parallel to it across its full length to allow proper manipulation. The same principle applies to completely endoscopic procedures, such as transoral thyroidectomy, where the complete dissection of the pyramidal lobe after the incision of the isthmus is necessary to fully mobilize and manipulate the lateral [18].

The strengths of this study are the fact that there is no bias as every patient who was subjected to total thyroidectomy in the given time period was included in the sample as well as the fact that the results of the study can be generalized due to the large number of the sample. Its limitations include the fact that not all macroscopically recognized pyramidal lobes were described in the histopathological report and the fact that the specimens were studied retrospectively.

5 CONCLUSION

The pyramidal lobe of the thyroid gland is an anatomical variation that is present at almost 50% of the cases and when existing, complexes the completeness of total thyroidectomy. It is the most common cause of incomplete excision and most common site of recurrence, as confirmed my postoperative scans with radioactive iodine. Therefore, knowledge of its anatomical traits, correct preoperative recognition and evaluation by using proper imaging techniques and application of effective tips and tricks is essential in achieving a true total thyroidectomy, which in turn will provide a curative result and better post-operative management.

COMPLIANCE WITH ETHICAL STANDARDS

Conflict of Interest: The authors declare that they have no conflict of interest.

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