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Case Report

Complex Variations of Double Pyramidal Lobe and Double Isthmus of the Thyroid Gland: A Case Report

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Abstract : The thyroid gland (TG) is an endocrine organ located at the level of the 5th cervical vertebra to 1st thoracic vertebra. The TG consists of right and left lobe, and the left lobe and the right lobe, and these two lobes are connected by the isthmus. The superior thyroid artery (STA) and the inferior thyroid artery (ITA) supply blood to the thyroid gland. We aimed to report complex variations of double thyroid lobes, double isthmus, and double pyramidal lobes to provide basic anatomical data for understanding clinical and pathological mechanisms. Thyroid variations were discovered while dissecting a cadaver at the College of Korean Medicine. In this case, the thyroid lobes, the isthmus, and the pyramidal lobes were formed independently on both sides. The thyroid lobes were divided into right thyroid lobe (RTL) and left thyroid lobe (LTL). The right pyramidal lobe (RPL) was connected from the superior border of the right isthmus (RIS) to the distal portion of the thyroglossal duct, and the left pyramidal lobe (LPL) was also connected from the superior border of the left isthmus (LIS) to the distal portion of the thyroglossal duct. The lengths of RTL, LTL, RIS, LIS, RPL, and LPL were 47.5 mm, 47.1 mm, 9.8 mm, 17.2 mm, 14.2 mm, and 20.3 mm, respectively. And the widths of RTL, LTL, RIS, LIS, RPL, and LPL were 17.0 mm, 13.9 mm, 6.0 mm, 11.3 mm, 4.8 mm, and 6.1 mm, respectively. The STA and the ITA was in a normal anatomical form, but the collateral circulation connecting the right and left sides did not exist. Since these variations may clinically lead to the possibility of incomplete thyroidectomy, clinicians need to understand the various variations of the TG and apply them to diagnosis and treatment.

Keywords : Thyroid gland, Double pyramidal lobe, Double isthmus, Anatomical variation

INTRODUCTION

The thyroid gland (TG) is an endocrine organ located at the level of the 5th cervical vertebra to 1st thoracic vertebra. It is located in front of the neck and deep to the infrahyoid muscles. The TG consists of right and left lobe, and the left lobe and the right lobe, and these two lobes are connected to the isthmus at the inferior part of the medial margin [1,2]. The TG begins to develop at the end of the third week of the embryonic period by proliferation of endoderm cells,

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located in the ventral wall of the primitive pharynx of the first and second pharyngeal pouches. The thyroglossal duct grows caudally and divides into two branches to form the thyroid lobes and isthmus [2,3]. The pyramidal lobe is formed in a triangular shape starting from the median of the inferior margin of the isthmus. The pyramidal lobe develops along the migratory path of the TG and is usually connected to the distal portion of the thyroglossal duct [4,5]. The incidence of isthmus agenesis has been reported to be 5% to 10%. Pyramidal lobes have various positions and shapes, and the frequency varies from 43% to 76.8% depending on race and gender [6-8]. The superior thyroid artery (STA), a branch of the external carotid artery, supplies blood to the anterosuperior part of the thyroid gland, and the posteroinferior part of the TG is supplied blood by the inferior thyroid artery (ITA), a branch of the subclavian artery. STA and ITA form collateral circulation in the right and left lobes [9]. Won et al. [6] proposed six types of TG based on the shape of the connection between both lobes and the isthmus. Marshall [8] classified the TG into 17 types according to the shape and location of the lateral lobes and the presence and shape of the isthmus and pyramidal lobe, and reported that the anatomical structure of the TG exists in many different forms. Additionally, Braun et al. [4] reported that indifference to anatomical variations of the thyroid gland, such as the incidence of pyramidal lobes or accessory glands, may lead to incorrect surgical procedures. Therefore, information about various variations of the TG can be surgically important.

We aimed to report complex variations of double thyroid lobes, double isthmuses, and double pyramidal lobes to provide basic anatomical data for understanding clinical and pathological mechanisms.

CASE REPORT

We discovered thyroid variations while dissecting the neck of a cadaver donated for educational and research purposes at the College of Korean Medicine. Before dissection, no signs of deformity, damage, or surgery were found on the neck of the cadaver of an 83-year-old man. In the supine position, the skin of the neck was incised and skin dissection was performed. The infrahyoid muscles were discovered and removed sequentially starting from the superficial layer. Finally, the TG was exposed. The anatomical structures of both thyroid lobes, double isthmus, double pyramidal lobes, and blood vessels were clearly identified (Fig. 1). The thyroid lobes were divided into right thyroid lobe (RTL) and left thyroid lobe (LTL). Each side of the isthmus was independent, and the size of the right isthmus (RIS) vs. the left isthmus (LIS) was approximately 1 : 3. The pyramid lobes were also formed independently on both sides. The right pyramidal lobe (RPL) was connected from the superior border of RIS to the distal portion of the thyroglossal duct, and the left pyramidal lobe (LPL) was also connected from the superior border of LIS to the distal portion of the thyroglossal duct. The thyroglossal ducts on both sides merged into one, connecting toward the tongue (Fig. 2).

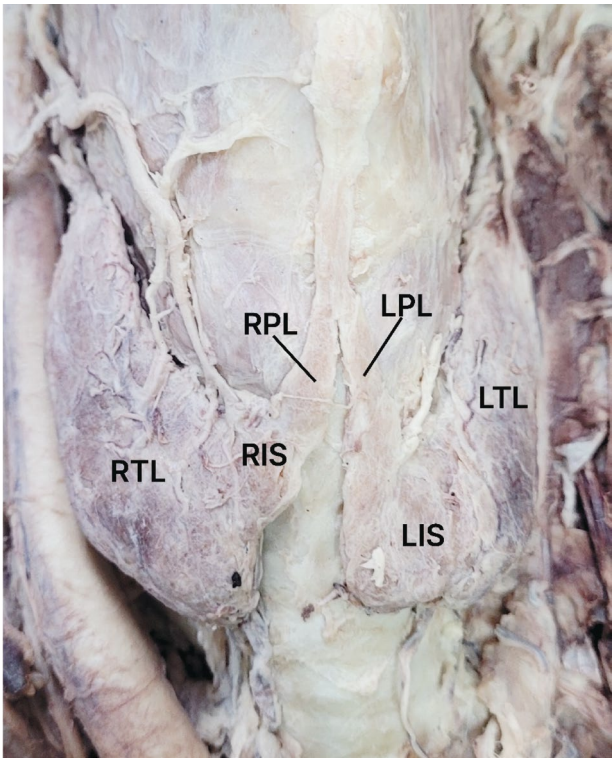

Fig. 1. Anterior view of the thyroid gland. It shows variations of bilateral thyroid lobes, double isthmus, and double pyramidal lobes. RTL, Right thyroid lobe; LTL, Left thyroid lobe; RIS, Right isthmus; LIS, Left isthmus; RPL, Right pyramidal lobe; LPL, Left pyramidal lobe.

The length and width of RTL, LTL, RIS, LIS, RPL, and LPL were measured by a digital caliper (CAS Co., Ltd.), and the minimum measurement unit was 0.1 mm. All lengths were measured at the longest point in the axial direction, and widths were measured at the widest point in the direction perpendicular to the length. As a result of the measurement,

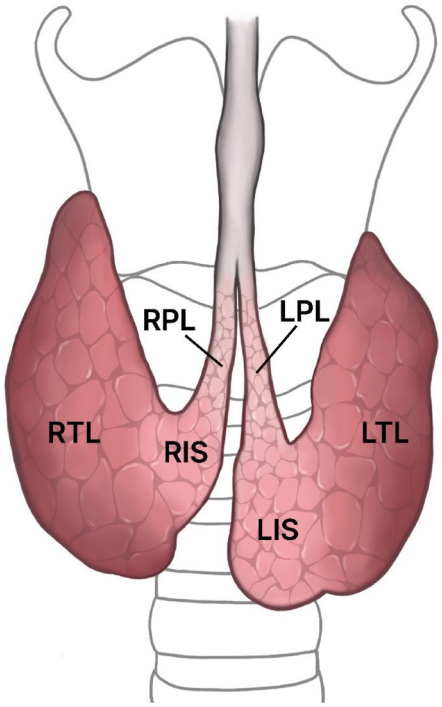

Fig. 2. Schematic representation of the complex variation of double thyroid gland. RTL, Right thyroid lobe; LTL, Left thyroid lobe; RIS, Right isthmus; LIS, Left isthmus; RPL, Right pyramidal lobe; LPL, Left pyramidal lobe.

the lengths of RTL, LTL, RIS, LIS, RPL, and LPL were 47.5 mm, 47.1 mm, 9.8 mm, 17.2 mm, 14.2 mm, and 20.3 mm, respectively. And the widths of RTL, LTL, RIS, LIS, RPL, and LPL were 17.0 mm, 13.9 mm, 6.0 mm, 11.3 mm, 4.8 mm, and 6.1 mm, respectively. STA branched to supply blood at the upper tip, midpoint, and isthmic junction of the thyroid lobe, respectively, but there was no collateral circulation. The ITA supplied blood to the lower area of the thyroid lobe, but did not provide collateral circulation connecting the left and right sides. In other words, the arterial supply was in a normal anatomical form, supplying blood to the TG, but the collateral circulation connecting the right and left sides showed a variation in which it did not exist.

DISCUSSION

In this case, the left and right lobes were not connected by isthmus and existed independently, and the sizes of RIS and LIS were approximately 1 : 3. Similar cases where both lobes are separated and an isthmus exists on both sides were not found in previous studies. The percentage of separated lobes was 3 to 15% in previous studies, which appeared variously according to race [6,8,10]. However, all of them were the cases of agenesis of isthmus, the two lobes being separated with no isthmus. The cases with two isthmuses, as in this case, were very rare in the literature review. In addition, there was no specific discussion on the frequency of agenesis of isthmus according to race, thus further research is needed.

In this case, the pyramid lobe exists in the form of bifurcating in both lobes. In previous studies, the presence of the pyramidal lobe was relatively common, with frequencies reported as 43% in British studies [8] and 76.8% in Korean studies [6]. However, double PL was rare in the literature review and was identified during total thyroidectomy [11]. Vithana et al. [12] and Gurleyik et al. [13] reported cases of double pyramidal lobe. However, unlike our case, which had a double pyramidal lobe and a double isthmus, the normal type of TG and isthmus had two pyramidal lobes connected on both sides. Opinions on whether this would be viewed as a variation of either isthmus or PL differed among authors. The pyramidal lobe is believed to be the residue of incompletely degenerated thyroglossal duct [14]. Therefore, we supposed that if the development occurred properly, this form would be the bifurcated PL attached to both lateral lobes. Still, further studies on the exact mechanism of development are needed.

In this case, when both lobes existed independently, the isthmus and pyramidal lobes were also independent. Won et al. [6] classified TG into six types, but there were no reports of cases like ours and they roughly classified it as an irregular shape. Marshall [8] proposed 17 types of TG, and our case was similar to the 13th type. However, previous studies have argued that although the pyramidal lobe and the thyroid lobe exist independently, there is no true isthmus in the general sense. Although our case shows a similar form in the type classification of the previous report, it is judged to be a case that was not included in the correct classification, and should be included in a more detailed classification method in the future type classification.

In this case, the lengths of RTL and LTL were 47.5 mm and 47.1 mm, and the widths were 17.0 mm and 13.9 mm, respectively. In a study performed in India [15], the average lengths of RTL and LTL were 42.4 mm and 40.8 mm, and the average widths were 17.6 mm and 18 mm, respectively. Compared with that, the two lobes in this case were relatively long and narrow in width. In a study performed in

UK [16], the average RTL length was 53 mm for males and 44.8 mm for females, and the average LTL length was 48.8 mm for males and 42.8 mm for females. In addition, the average RTL width was 38.1 mm for males and 28.2 mm for females, and the average LTL width was 31.8 mm for males and 25.7 mm for females. The lobe length in this case was similar to the average in previous studies, and the width was smaller by a large difference. The size of thyroid lobe varied depending on several causes, such as race and gender.

In this case, the lengths of RPL and LPL were 14.2 mm and 20.3 mm, and the widths were 4.8 mm and 6.1 mm, respectively. In a study performed in India, the average of PL length was 23.1 mm and the average of width was 10.1 mm [15]. In a study in the Republic of Serbia, the average of PL length was 22.6 mm and the average of width was 11.2 mm [17]. Compared to the previous case with only one PL, the length of this case was similar for the longer of the two PL. However, the width was similar to the sum of the widths of the double PL. This was thought to be relatively narrow because the PL was divided into two.

In this case, the two lobes of the TG are not connected, and there are two pyramidal lobes and isthmuses. The development of TG begins with thickening of the mediastinum at the bottom of the pharynx between the 1st and 2nd pharyngeal pouches. This grows by allometric proliferation to become a solid cellular cord called the thyroglossal duct. The pyramidal lobe is a remnant of the incompletely degenerated thyroglossal duct and can form two lobes if excessively separated [14,18]. At this time, there is a possibility that the formed pyramidal lobe and isthmus may each be separated into two.

In this case, STA and ITA exist and supply blood to superior and inferior part of the thyroid gland, respectively, but the arteries of left and right side do not form anastomosis. The previous case reports also showed a form in which two lobes were separated, and anastomosis did not exist between the arteries of left and right side [19,20]. Morphologically, it seems that anastomosis does not occur due to the separation of the two lobes. In addition, total thyroidectomy is mainly used as a treatment for thyroid cancer today. But in this case, it may be possible to resect only a part of the TG when cancerous tissue only exists in one lobe, since there is no path of blood circulation to the other lobe. These variations should be approached carefully during trans-thyroid tracheostomy procedures.

In this study, the thyroid lobe, isthmus, and pyramidal lobe were present on both sides, and cases such as double pyramidal lobe are very rare [11,21]. Surgical removal is the only effective treatment for thyroid nodular disease, and the presence of double pyramidal lobes is information that clinicians must consider to completely remove thyroid tissue. However, the presence of the pyramidal lobe is underestimated in medical visualization such as preoperative scintigraphy and computed tomography, and incomplete resection in thyroidectomy may cause recurrence of benign or malignant nodular disease [4,17]. Therefore, clinically, the presence of variant forms of double pyramidal lobe should be treated with caution.

In this paper, we discovered a complex variant in which the two thyroid lobes have separate double isthmus and double pyramidal lobes, and the blood vessels supplying the thyroid do not anastomose with the opposite vessels. These variations may clinically lead to the possibility of incomplete thyroidectomy. Therefore, clinicians need to understand the various variations of the TG and apply them to diagnosis and treatment.

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