Identification and Preservation of Parathyroid Glands in Cadaver Parts

Identificação e Preservação de Glândulas Paratiróides em Peças de Cadáver

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ABSTRACT

Introduction: It is essential to know the thyroid gland morphology and its anatomical relations in the anterior compartment of the neck in order to minimize the rate of thyroid surgery morbidity, especially the lesion of parathyroid glands and laryngeal nerves. The aim of this study was the identification of parathyroid glands in cadaver parts and their histological confirmation.

Material and Methods: Twenty cadaver parts were used to simulate thyroidectomies. During dissection, the thyroid glands and eventual parathyroid glands were isolated and then submitted to histological study.

Discussion: Twenty cadaver parts (anterior cervical organs) were used for macroscopic dissection during which 48 fragments that corresponded to eventual parathyroid glands were isolated, 35 of which were effectively confirmed through histological observation to be parathyroid glands. The 20 cadaver parts were then divided into three groups according to the number of histologically confirmed parathyroid glands. In the first group, composed of 11 cases, all eventual parathyroid glands were confirmed. In the second group, composed of six cases, only some glands were confirmed. In the third group, composed of three cases, none of the possible glands were confirmed. In seven of the 20 isolated thyroid glands, eight parathyroid glands were identified during histological study: four sub-capsular, three extra-capsular, one intra-thyroidal. There was no statistical relation in the dimensions of the parathyroid glands.

Conclusions: The knowledge of the anatomy of the central visceral compartment of the neck and its most frequent variations reduces but doesn't eliminate thyroid surgery morbidity, especially parathyroid iatrogenic excision, difficulty which has been demonstrated during the dissection of cadaver parts.

Keywords: Cadaver; Parathyroid Glands; Histological Techniques.

RESUMO

Introdução: É indispensável ter um conhecimento profundo da morfologia da glândula tiróide e das estruturas com ela relacionadas no compartimento anterior do pescoço, para minimizar a morbilidade decorrente da cirurgia da tiróide, nomeadamente a lesão das glândulas paratiróides e dos nervos laríngeos. Este estudo pretendeu identificar glândulas paratiróides em peças de cadáver, confirmando-as histologicamente.

Material e Métodos: Foram usadas 20 peças de cadáver para simular tiroidectomias. Durante a dissecção, foram isoladas as glândulas tiróides e eventuais glândulas paratiróides, que foram submetidas a estudo histológico.

Discussão: Foram dissecadas 20 peças de cadáver (regiões cervicais anteriores), sendo isolados 48 fragmentos que correspondiam a eventuais glândulas paratiróides, dos quais 35 foram confirmados histologicamente como sendo efectivamente paratiróides. Os 20 casos foram, então, divididos em três grupos, de acordo com o número de paratiróides confirmadas histologicamente. No primeiro grupo, constituído por 11 casos, todas as eventuais paratiróides foram confirmadas. No segundo grupo, constituído por seis casos, apenas algumas paratiróides foram confirmadas. No terceiro grupo, constituído por três casos, nenhuma das eventuais paratiróides isoladas era efectivamente paratiróide. Em sete das 20 glândulas tiróides isoladas, foram identificadas oito paratiróides no estudo histológico: quatro sub-capsulares; três extra-capsulares e uma intra-tiróideia. As dimensões das paratiróides não tinham relação estatisticamente significativa.

Conclusão: O conhecimento da anatomia das estruturas do compartimento central do pescoço e das suas variações mais frequentes diminui, mas não elimina a morbilidade da cirurgia da tiróide, nomeadamente a excisão iatrogénica das paratiróides, cuja dificuldade de identificação foi evidenciada nas peças dissecadas.

Palavras-chave: Cadáver; Glândulas Paratiróides; Histologia.

INTRODUCTION

The anatomy of the central neck compartment is fairly complex and should be comprehensively studied in order to reduce the complications associated with thyroid gland (TG) surgery. Several major structures are located in this region, defining anatomic relationships which are difficult to recognize and which are the subject of several variations. From a physiological point of view, there are many fragile and important structures surrounding the TG, mainly the recurrent laryngeal nerve and the parathyroid glands (PTG).

PTG have a rounded or lenticular shape, with variable location and number, surrounding the TG. Despite their small size, the PTG are crucial for calcium metabolism homeostasis which is, in turn, related to muscular contraction and neurotransmission processes.[1]

The PTG normally present a yellowish-brown coloration and are surrounded by adipose tissue in a variable amount. Colour changes with age, being lighter in the newborn and during childhood.[2] However, its identification is always as

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difficult in patients as in cadavers.[2] In most cases, there are four glands, two upper and two lower, although its number may range between two and nine glands.[3] PTG are mostly located close to the posterolateral surface of the lobes of the TG; they may also be found in the space between the hyoid bone and the upper mediastinum.[4] In some cases, the PTG may be situated within the thyroid parenchyma when they are referred as intrathyroidal PTG.[4,5]

One of the major complications in thyroid surgery is hypocalcaemia due to the accidental removal of the PTG. Postoperative hypocalcaemia may be due to an accidental parathyroid removal or, more commonly, due to parathyroid devascularization.[6] According to some authors the frequency of postoperative hypoparathyroidism may range between 1 and 15%.[7,8] In most cases, only one PTG is unintentionally removed.[7] Some authors refer that postoperative hypoparathyroidism symptoms may be avoided through preservation of only one gland during thyroid surgery.[6,9,10] Others consider that a minimum of three glands is necessary to preserve normal activity.[10,11] A thorough knowledge of PTG anatomic location and relationships with the other cervical structures is crucial in order to identify and preserve PTG during thyroid surgery.[12] It is necessary to know how to differentiate its yellowish-brown colour from surrounding tissues, namely adipose tissue and to be prepared to identify the most frequent PTG anatomical variants. It is also important to preserve its blood supply, through individual ligation of the lower thyroid artery branches close to the TG while keeping the PTG *in situ* inside their adipose tissue envelope.[13,14] Nevertheless, these procedures do not exclude the knowledge of PTG anatomic morphology, location and relationships. The incidental removal of PTG may be reduced using a meticulous surgical technique and by improvement of the surgeon's individual experience.[15-17]

The aim of this work was to identify and isolate TG and PTG during dissection of 20 cadaver cervical region body parts and to identify anatomic PTG variations that may hinder their identification. It was also our objective, through histological examination, to confirm the presence of suspected PTG identified in dissection as well as to identify intrathyroidal PTG that were not identified in dissection.

MATERIAL AND METHODS

Twenty cadaver body parts (anterior cervical organs) have been used, collected from autopsies performed at the National Forensic Institute in Coimbra. A macroscopic dissection of the samples was performed, simulating a thyroidectomy.

During dissection, visual exploration of the most frequent PTG placements was performed, with isolation of some fragments as possible PTG. Upon dissection, the fragments considered as eventual PTG were submitted to histology, in order to confirm its PTG nature. The twenty TG isolated during dissection were also been submitted to histological examination, in order to identify any intrathyroidal PTG that was not identified during dissection. Histological examination was performed at the Institute of Pathology from the Faculty of Medicine of Coimbra University. After obtaining the results of macroscopic dissection and histological examination, the twenty samples were divided in three groups, according to the number of glands identified during dissection and confirmed by histology. A statistical analysis has been carried out, using Chi-square test (SPSS 15.0), in order to evaluate statistical significance of PTG sizes in the three groups. A value of $p < 0.05$ was considered as statistically significant.

RESULTS

In the twenty cervical region body parts submitted to dissection (anterior cervical organs) (Fig. 1), forty-eight fragments were isolated as possible PTG tissue (2.4 PTG identified per TG, on average).

The forty-eight possible PTG were isolated in the places were they are mostly located: 13 referred to upper right parathyroid (URP), 11 to upper left parathyroid (ULP), 11 to lower right parathyroid (LRP) and 13 to lower left parathyroid (LLP) (Table 1). The histological analysis of the 48 possible PTG identified in dissection confirmed that 35 (73%) were actually PTG (10 URP, nine ULP, six LRP and 10 LLP) (Table 1), with a medium size of 3.2 mm (minimum: 1 mm; maximum: 7 mm). The other 13 possible PTG (27%) consisted of adipose tissue alone.

Figure 1 - Image of dissected sample. White arrows show the parathyroid glands.

With the results of dissection and histological examination, the twenty cases were divided in three groups, according to the number of PTG confirmed in histology (Figure 2, Table 2). Group I included 11 cases, in which 24 possible PTG have been isolated in dissection (1 PTG found in one case, 2 PTG in eight cases; 3 PTG in one case; 4 PTG in one case) and all the eventual PTG were confirmed by histology as parathyroid tissue. PTG medium sizes were of 3.3 mm (minimum: 1 mm and maximum: 7 mm). Group II included six cases, in which twenty possible PTG were isolated, although only 11 (55%) were confirmed as PTG. They presented a medium size of 3.1 mm (minimum: 1 mm and maximum: 6 mm). Group III included three cases, in which none of the four possible PTG which were isolated in dissection was confirmed as PTG by histology.

The histological examination of the twenty TG revealed eight PTG that were not detected during dissection (Table 2).

In one TG from Group I, one intrathyroidal PTG was identified in the right lobe, with a diameter of 3 mm; in three TG from Group I and one TG from Group II, four subcapsular PTG were identified (1 subcapsular PTG per each GT), with a medium size of 2.75 mm (minimum - 1 mm and maximum - 4 mm), three PTG were found in the right lobe and one PTG in the left lobe; in one TG from Group II, one extracapsular PTG was identified in the right lobe, with a size of 3.0 mm; in one TG from Group III, two extracapsular PTG were identified in the left lobe, with a diameter of 3 mm. The extracapsular PTG histological examination revealed atrophic parathyroid tissue and that part of the parenchyma had been replaced by adipose tissue (Figure 3 and 4).

Table 2 shows the data presented above, relating the number of PTG identified in the dissection with the number of PTG confirmed by histological examination.

The statistical study has been carried out in order to determine the presence of statistical significance between PTG sizes in the three groups. However, no statistical correlation has been found between data sets ($p > 0.05$). In one case (Case number 12), the isthmus was absent from the TG.

Table 1 - Number of parathyroid glands identified in dissection and confirmed in histology.

Parathyroid	"Presumed" PTG identified in dissection	Confirmed PTG in histology
URP	13	10
ULP	11	9
LRP	11	6
LLP	13	10

Note: URP: upper right parathyroid; ULP: upper left parathyroid; LRP: lower right parathyroid; LLP: lower left parathyroid.

Table 2 - Number of isolated and confirmed PTG.

Groups	Cases	Nº of "presumed" PTG	Histological examination	
			Nº PTG in fragments	Nº PTG in thyroid gland
Group I	Case 1	3	3	1 (subcapsular)
	Case 2	2	2	1 (subcapsular)
	Case 3	2	2	-
	Case 4	2	2	-
	Case 6	2	2	1 (extracapsular)
	Case 11	1	1	1 (intrathyroidal)
	Case 12	4	4	-
	Case 13	2	2	-
	Case 14	2	2	-
	Case 15	2	2	1 (subcapsular)
	Case 18	2	2	-
Group II	Case 5	2	1	-
	Case 8	4	2	-
	Case 9	4	3	-
	Case 10	3	2	-
	Case 17	4	2	-
	Case 20	3	1	1 (subcapsular)
Group III	Case 7	2	-	2 (extracapsulares)
	Case 16	1	-	-
	Case 19	1	-	-

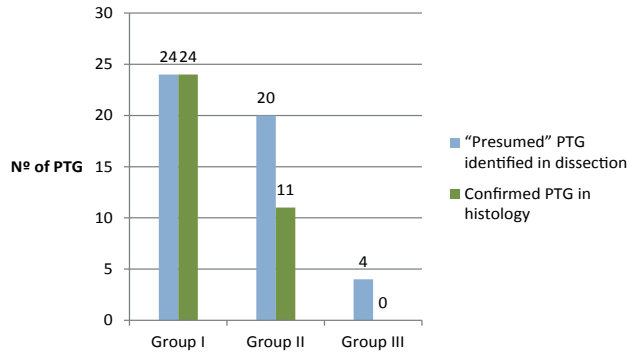

Figure 2 - Distribution of dissected specimens in three groups, according to the number of parathyroid glands confirmed in histology.

DISCUSSION

Forty-eight fragments isolated in the macroscopic dissection of twenty cadaver body parts (cases) from the cervical region would presumably represent PTG. The upper PTG location have been described as more predictable than lower PTG,[18] but, in this work, we did not find any significant differences related to the identified PTG location (13 URP, 11 ULP, 11 LRP and 13 LLP).

From the 48 fragments isolated in the 20 cases, 35 (73%) were confirmed by histology as PTG tissue (10 URP, nine ULP, six LRP and 10 LLP). The relative percentage of confirmed LRP (6/11 = 54%) was lower than those of URP (10/13 = 77%), ULP (9/11 = 81%) and LLP (10/13 = 77%).

The remaining 13 fragments (27%) isolated in dissection referred to adipose tissue. The 35 PTG presented a medium size of 3.2 mm (minimum of 1 mm and maximum of 7 mm).

After dissection, the 20 cases were divided in three groups, according to the number of PTG confirmed in histology (Figure 2, Table 2). In 11 cases (55% of the twenty dissected body parts), all the PTG isolated have been confirmed in the histological examination. In six cases (30% of the twenty dissected body parts), the histological examination confirmed that only 11 (55%) of the identified fragments were actually PTG, with a medium size of 3.1 mm. The other nine fragments that did not represent PTG were isolated in dissection because they presented a yellowish-brown coloration and because they were located in places where PTG are more likely to be found. Those six cases could only present the number of PTG that were confirmed by the histological examination or perhaps the remaining PTG which were not identified would be located in locations where it is less likely to find PTG and which were not properly examined in dissection.

The twenty TG isolated in dissection were submitted to histological examination. In seven (35%) of the 20 TG, eight PTG had not been identified in dissection: four subcapsular PTG; three extracapsular PTG and one intrathyroidal PTG. Most of subcapsular PTG (3/4) were found in TG right lobe.

Subcapsular PTG and intrathyroidal PTG were not identified during dissection due to its location, which defies their distinction from thyroid tissue. Extracapsular PTG were considered as atrophic in histology, with a changed morphology, what probably complicated their correct identification.

Extracapsular PTG presented its parenchyma partially replaced by adipose tissue, a factor which may change the usual tan coloration of PTG and complicate their identification.

One of the PTG identified by histology was intrathyroidal. According to the work by Cernea et al in 56 cadavers, intrathyroidal PTG were found in 5.6% of the cases.19 According to McIntyre *et al*., intrathyroidal PTG frequency may reach 7% of the cases.[20] Sakorafas et al[7,20] described that a significant percentage of incidentally removed PTG were actually intrathyroidal PTG.7 In one study carried out in 56 cadavers by Hojaij F, ectopic PTG were found in 42.8% of the cases, where 12.5% were subcapsular and 5.4% were intrathyroidal.

The statistical study demonstrated that there were no statistical significance between PTG sizes in the three groups and PTG sizes identified by histology.

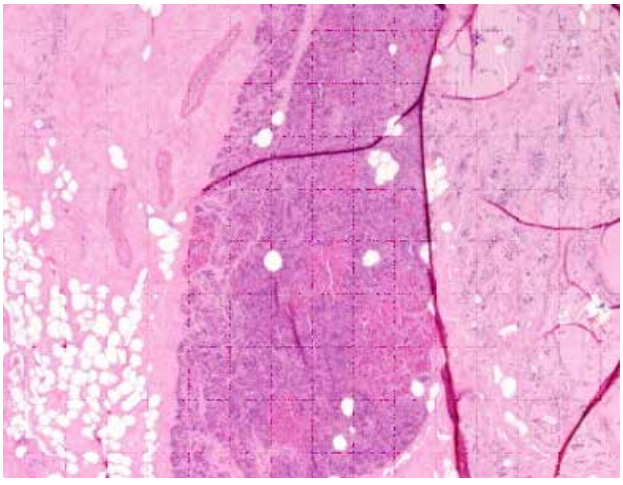

Figure 3 – Intrathyroidal parathyroid gland. Case 11 image, showing a intrathyroidal parathyroid gland. HE X 40.

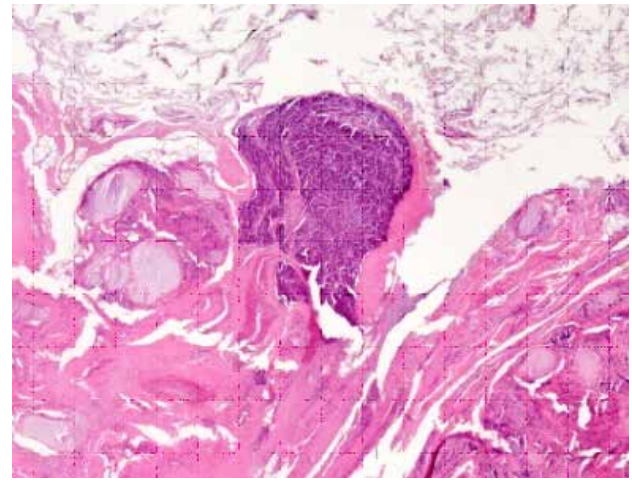

Figure 4 – Subcapsular parathyroid gland: Case 1 image, showing a subcapsular parathyroid gland. HE X 40.

CONCLUSIONS

Seventy-three percent of the possible PTG isolated through dissection were confirmed by histology. All PTG isolated in 30% of the dissected body parts were confirmed and in 55% only some PTG were confirmed by histology. In 35% of the TG, histology found eight PTG: four subcapsular; three extracapsular and one intrathyroidal. Extracapsular PTG were atrophic, with partial replacement by adipose tissue, which may have made its identification difficult in dissection. PTG sizes did not present a statistical correlation.

This work shows difficulties in identification of PTG during thyroid surgery and therefore highlights the importance of precise knowledge of the anterior neck compartment anatomy.

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CONFLICT OF INTERESTS

The authors declare that there was no conflict of interests in writing this work.

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