Journal of Cranio-Maxillo-Facial Surgery 42 (2014) 657–660

Contents lists available at ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Determining the number of intraparotid lymph nodes: Postmortem examination

Selma Sönmez Ergün [a,*], Özcan Gayretli [b], Nur Büyükpınarbaşılı [c], Kemalettin Yıldız [a], İlke Ali Gürses [b], Abdullah Avşar [d], Mehmet Cavlak [d]

[a] Department of Plastic, Reconstructive and Aesthetic Surgery, Bezmialem Medical School, Bezmialem Vakif University, Istanbul, Turkey
[b] Department of Anatomy, Istanbul Medical School, Istanbul University, Istanbul, Turkey
[c] Department of Pathology, Bezmialem Medical School, Bezmialem Vakif University, Istanbul, Turkey
[d] Institute of Forensic Medicine, Ministry of Justice, Istanbul, Turkey

ARTICLE INFO

Article history:
Paper received 30 May 2013
Accepted 13 September 2013

Keywords:
Intraparotid lymph nodes
Sentinel lymph node biopsy
Parotidectomy
Postmortem examination

ABSTRACT

Background: The parotid gland is one of the metastatic drainage areas for malignant tumours of the head and neck area. In this study, we aimed to define the accurate number and distribution of intraparotid lymph nodes in the 84 glands of 42 fresh cadavers for implementing the data for the clinical practice.
Methods: Bilateral total parotidectomies were performed. The lobes were separated, fixed with formalin, cut into thick slices, embedded in paraffin and serially sectioned. 2 μm thick sections were stained and examined histopathologically.
Results: No nodes were found in 4 of 84 superficial parotid lobes and in 58 of 84 deep parotid lobes.
Conclusions: Sentinel lymph node biopsy failure may be related to the absence of intraparotid lymphoid tissue. Although the superficial intraparotid lymph nodes are a first echelon of head and neck tumours, involvement of these does not allow us to exclude the possibility of involvement of the deep lobes.
© 2013 European Association for Cranio-Maxillo-Facial Surgery. Published by Elsevier Ltd. All rights reserved.

1. Introduction

The parotid gland primordia (anlage) arises in weeks 5–6 of embryonic life from the epithelial lining of the primitive stomodeum as solid buds. They proliferate as cords, form terminal bulbs, develop clefts and further proliferate as branches from the original cords. These branching epithelial cords become excretory ducts and their distal ends differentiate into the acini. The adjacent surrounding mesenchyme forms the capsule of the parotid gland. Although the parotid gland has only one lobe, it is arbitrarily divided in two parts as superficial and deep lobes due to the presence of the intraparotid facial nerve. This artificial division is clinically important for determining the surgical approach such as superficial or total parotidectomy according to the location of the tumoural mass (Espin-Ferra et al., 1991; Rodrigues et al., 2009; Mafee, 2012).

The lymphatic system of the neck develops after encapsulation of submandibular and sublingual glands and before encapsulation of the parotid glands. For that reason the other major salivary glands do not have a lymphatic system, whereas parotid glands have their own lymphatics due to relatively late embryological encapsulation (Mafee, 2012).

The parotid gland is considered as a metastatic drainage area for malignant tumours such as melanoma and cutaneous SCC of head and neck, with high-risk sites draining via lymphatic vessels located on or around the ear, cheek, or temple/forehead (O'Brien, 2005; Mourouzis et al., 2009).

In head and neck cancer patients, localization of pathological lymph nodes and lymph node staging are crucial for determining a patients' prognosis as well as developing a treatment algorithm. Nodal metastases can be categorized as overt and occult metastases. While radiological images such as ultrasound with or without colour. Doppler imaging, contrast-enhanced computed tomography, contrast-enhanced magnetic resonance imaging, and positron emission tomography scans play an important role in the detection of lymph nodes and overt metastases; lymphatic mapping and sentinel lymph node biopsy (SLNB) play an important role in the detection of clinically occult metastases by offering more accurate surgery based on each patient's unique lymphatic drainage pattern (Vogl and Bisdas, 2007; Sarnavan et al., 2002; Roarke et al., 2007; van den Brekel and Castelijns, 2005; Picon et al., 2006).

In order to evaluate the SLNB procedure correctly and to obtain a radical oncologic result, it is necessary to know the accurate

* Corresponding author. Estonşehir 3, Mahalle Ilgın Sokak, CD Villa 7/2, Başakşehir, Bahçeşehir, Istanbul, Turkey. Tel.: +90 212 691 52 56; fax: +90 212 621 75 80.
E-mail address: selmasonmezergun@yahoo.com (S. Sönmez Ergün).

1010-5182/$ – see front matter © 2013 European Association for Cranio-Maxillo-Facial Surgery. Published by Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.jcms.2013.09.011

number and distribution of the intraparotid lymph nodes. For that reason this postmortem autopsy study was performed to determine the number and distribution of intraparotid lymph nodes.

2. Material and methods

This study was performed on fresh cadavers that were sent to the Forensic Science Laboratory for legal autopsy between June 2012 and September 2012. 84 samples were obtained from 42 fresh cadavers (female, *n*: 9; male, *n*: 33) who had no head and neck malignancies, reticuloendothelial system diseases and any kind of infections or previous hospitalization before the death.

The study was approved by the ethical committee of Forensic Science, Ministry of Justice (B.03.1.ATK.0.01.00.08/359).

Bilateral total parotidectomies were performed within the first 24 h after death by the same anatomist. The superficial lobe of the parotid gland was marked with Indian ink, trunk of the fascial nerve was marked with black silk suture and then each total parotidectomy specimen was placed into two boxes for each fresh cadaver. The lobes were separated as superficial and deep lobes by the same plastic surgeon via dissection through the branches of the facial nerve and then each lobe was placed into a separate box containing 10% formalin for further pathological examination. Each lobe was cut into 2 mm thick slices in coronal plane and then these slices were embedded in paraffin and sectioned serially. Two-micrometre thick sections were subjected to haematoxylin–eosin staining. All slides were subjected to light microscopic examination and evaluated by the same pathologist. All groups of lymphocytes that were found with, or without, a germinal centre, surrounded by a capsular structure and associated with peripheral and central sinuses were accepted as a lymph node and counted. Statistical analyses were done using Fisher's Exact Test. A p value <0.05 was considered statistically significant.

3. Results

The mean age of the fresh human cadavers in the series was 53.6 years with a range from 37 to 78 years.

As shown in Table 1, there were no significant differences in the number of nodes of the right and left superficial and deep parotid lobes between male and female cadavers. Mean lymph node distribution according to age groups is shown in Table 2.

118 lymph nodes (range 0–7, mean 2.8) were identified in the right superficial parotid lobes and 132 lymph nodes (range 0–11, mean 3.1) were identified in the left superficial parotid lobes. 16 lymph nodes (range 0–3, mean 0.3) were identified in the right deep parotid lobes and 19 lymph nodes (range 0–3, mean 0.4) were identified in the left deep lobes.

While no nodes were found in 4 of the superficial parotid lobes (right superficial parotid lobe, *n*: 1; left superficial parotid lobe, *n*: 3), contralateral superficial lobes had lymph nodes ranging 1–3. However, in those four cadavers with no lymph nodes in the superficial lobes there were no lymph nodes in either of the deep lobes (Table 3).

No nodes were found in 58 of the deep parotid lobes (right deep parotid lobe *n*: 30; left deep parotid lobe, *n*: 28). While in 8 cadavers, 1–3 lymph nodes were found in both deep lobes, 1–3 lymph nodes were found in only one deep lobe in 10 cadavers and no nodes were found in either deep lobe in 24 cadavers (Table 3).

4. Discussion

The parotid lymph nodes are classified according to their position and relationship to the parotid gland as periglandular and intraglandular lymph nodes. Although some variations are observed in the lymphatic drainage of the face, it follows several general patterns. The forehead, lateral temporal and periorbital regions drain as a first echelon into periparotid or intraparotid lymph nodes and then drain into the upper jugular chain (Bentsianov and Blitzer, 2004).

In head and neck cancers, lymph node staging and localization of pathological lymph nodes are one of the major factors for the prognosis and determining whether to give either adjuvant/neo-adjuvant or surgical therapy to these patients (Vogl and Bisdas, 2007).

Parotidectomy and/or neck dissection, with subsequent pathological examinations, should be performed in patients with overt metastases to determine exact number of lymph nodes involved and to give accurate staging in the high-risk sites mentioned above. Lymphatic mapping and SLNB have gained popularity due to decreased morbidity in clinically node-negative disease. Lymphatic mapping and SLNB can provide both reliable information on the status of regional lymph nodes and detection of metastatic nodes at unexpected locations without the need for dissection of an entire nodal chain (Picon et al., 2006).

While lymphatic mapping and SLNB are valuable for detecting occult metastases, some challenging points remain in the head and neck area compared with other anatomic locations, especially in the parotid region. For example, SLNBs which are close proximity to the injection site may be obscured. Small sentinel nodes, located in

Table 1
Presence (+) or absence (−) of the lymph nodes according to the gender.

	Right superficial parotid nodes		Left superficial parotid nodes		Right deep parotid nodes		Left deep parotid nodes	
	+	−	+	−	+	−	+	−
Male	32 (97%)	1 (3%)	30 (90.9%)	3 (9.1%)	9 (27.3%)	24 (72.7%)	12 (36.4%)	21 (63.6%)
Female	9 (100%)	0 (0%)	9 (100%)	0 (0%)	3 (33.3%)	6 (66.7%)	2 (22.2%)	7 (77.8%)
p	0.756		0.475		0.699		0.692	

There were no significant differences in the presence or absence of nodes of the right and left superficial and deep parotid lobes between male and female cadavers (Fisher's Exact Test).

Table 2
Mean lymph node distribution according to age groups.

		Superficial lobe		Deep lobe	
Total number (*n*: 42)	Age groups	Right	Left	Right	Left
6	30–39	3.5	3.6	0.3	0.6
14	40–49	3.2	4.4	0.7	0.8
9	50–59	2.3	2.4	0.2	0.2
10	60–69	2.6	2.0	0.1	0.1
3	70–79	1.6	2.0	0.0	0.0

Table 3
Presence (+) or absence (−) of the lymph nodes according to the parotid lobes.

Total cadavers *n*: 42								
Right parotid superficial (*n*: 42) and deep lobes (*n*: 42)				Left parotid superficial (*n*: 42) and deep lobes (*n*: 42)			
s+ d+	s+ d−	s− d+	s− d−	s+ d+	s+ d−	s− d+	s− d−
n: 12 (28.5%)	*n*: 29 (69%)	*n*: 0 (0%)	*n*: 1 (2.3%)	*n*: 14 (33.3%)	*n*: 25 (59.5%)	*n*: 0 (0%)	*n*: 3 (7.1%)

s: superficial parotid lobe, d: deep parotid lobe.

the parotid gland cannot be accessed easily. The blue dye travels rapidly, for that reason less frequent visualization occurs. There is a possibility of higher morbidity due to the proximity of lymph nodes to neurovascular structures (Shpitzer et al., 2007; Samra et al., 2012).

In some cases, preoperative lymphoscintigraphy and intraoperative lymphatic mapping to identify an area of uptake can fail.

Sentinel lymph node (SLN) failure rates are reported as 0–14% in the literature. Picon et al. (2006) reported five patients in whom the preoperative lymphoscintigraphy failed in identification of uptake areas. They could have identified sentinel node using isosulfan blue dye in four of these five patients, but this attempt was failed in one patient. Of the four patients, three underwent superficial parotidectomy, and in one of these patients, the parotidectomy specimen revealed metastatic disease. In the patient with unsuccessful SLN identification with isosulfan blue dye, due to tumour proximity to the parotid gland, superficial parotidectomy was performed. They did not report whether the patient had intraparotid lymph node metastasis. Loree et al. (2006) reported that in 27 of 28 patients, an intraparotid SLN was identified and in one patient, pathological examinations did not reveal any lymphoid tissue despite a high count in the parotid tissue excised. Reported SLNB failure rates and failure to reveal any lymphoid tissue in the parotid gland may be related to the absence of intraparotid lymphoid tissue as shown in this study.

SLN dissection in the parotid region can be carried out with the parotid-sparing SLNB, superficial parotidectomy or total parotidectomy. It was reported that SLNB of intraparotid nodes is a reliable procedure with the high rate SLN identification. SLNB can also give false-negative results in some cases. False-negativity presents itself as regional lymph node recurrence in the same chain that the sentinel node was previously harvested from (Samra et al., 2012; Loree et al., 2006).

Same-chain recurrence rates may be variable according to the primary tumour site. The patients with SLN mapping to the parotid region have a higher same-chain recurrence rate (3.1–7%) compared with SLN mapping to extremity and trunk melanoma (Samra et al., 2012; van Akkooi et al., 2010; Stárek et al., 2006; Ollila et al., 1999; Wells et al., 1999).

The parotid-sparing SLNB, despite being presented as a new method with low morbidity may lead to an increase in same-basin recurrence rates in this region due to some difficulties mentioned above.

Metastasis of cutaneous malignancy to the lymph nodes of the parotid gland is uncommon, but once the parotid gland is involved by metastatic spread, it creates management problems for the surgeon due to the presence of the facial nerve within the parotid gland (McKean et al., 1985).

How can a radical oncologic result be obtained by performing superficial parotidectomy or by extending the dissection to the deep lobe? Knowing the answer is important for the surgeon in clinical practice. For this reason, topographical distribution of the intraparotid lymph nodes is essential in the planning of surgical treatment of parotid metastases (Gratea-Crelgo et al., 1993).

McKean et al. (1985) found a variable number of lymph nodes (2–22) in all of the superficial lobes and stated that 90% of total parotid nodes are located in the superficial lobe of the parotid gland in their ten-cadaver postmortem examination. Our study data (87.7%) supported the data of McKean et al. (1985) with 90% of the lymph nodes located in the superficial lobe, but we found the number of lymph nodes varied from 0 to 11. No lymph nodes were found in 4 of 84 superficial lobes in our study (4.7%).

McKean et al. (1985) found varying numbers of lymph nodes (0–4) in the deep lobe, but they did not find any lymph nodes in 10 deep lobes. We found similar lymph node variation (0–3) in the deep lobes and no lymph nodes in 58 of 84 deep lobes were found (69%).

Because the deep intraparotid lymph nodes are not always verifiable Marks (1984) and McKean et al. (1985) have concluded that their presence is less important in clinical context. Although Jackson and Ballantyne (1981), Santini et al. (1985), and Caldwell and Spiro (1988) emphasize that superficial parotidectomy provides good local control of the disease in the absence of evident involvement of the deep lobe, (ranging from 25 to 38%) in some cases of Jackson and Ballantyne (1981) they proceeded to total parotidectomy.

After the superficial parotidectomy, secondary involvement of the deep lymph nodes may be seen due to direct and indirect lymphatic connections between the superficial and deep lymph nodes as indicated by Pisani et al. (1996). In clinical practice, we encountered the secondary involvement of deep lymph nodes in one of our five cases of parotid metastasis (one primary unknown melanoma, four squamous cell carcinoma) with supraorbital squamous cell carcinoma displaying angiolymphatic invasion. Therefore, deep lymph nodes should be taken into consideration in clinical context due to the possibility of their secondary involvement in some cases mentioned above.

5. Conclusion

The probability of microscopic involvement of lymph nodes for any tumour may not be estimated even if primary tumour site, histopathology, imaging, surgeon's past individual experiences and reported experiences in the literature are taken into consideration. Although the findings confirm the superficial intraparotid lymph nodes as a first echelon of forehead, lateral temporal, frontal and periorbital regions, their involvement does not allow us to exclude the possibility of involvement of the deep lobes. If the tumour has one or more high-risk criteria such as angiolymphatic invasion, perineural invasion, rapid growth pattern over a short time interval or is poorly differentiated, the deep lobe should be addressed with a conservative total parotidectomy according to traditional approach which is still valid.

References

Bentsianov B, Blitzer A: Facial anatomy. Clin Dermatol 22: 3–13, 2004

Caldwell CB, Spiro RH: The role of parotidectomy in the treatment of cutaneous head and neck melanoma. Am J Surg 156: 318–322, 1988

Espin-Ferra J, Merida-Velasco JA, Garcia-Garcia JD, Sanchez-Montesinos I, Barranco-Zafra RJ: Relationships between the parotid gland and the facial nerve during human development. J Dent Res 70: 1035–1040, 1991

Gratea-Crelgo J, Gay-Escoda C, Bermejo B, Buenechea-Imaz R: Morphological study of parotid lymph nodes. J Craniomaxillofac Surg 21: 207–209, 1993

Jackson GL, Ballantyne AJ: Role of parotidectomy for skin cancer of the head and neck. Am J Surg 142: 464–469, 1981

Loree TR, Tomljanovich PI, Cheney RT, Hicks Jr WL, Rigual NR: Intraparotid sentinel lymph node biopsy for head and neck melanoma. Laryngoscope 116: 1461–1464, 2006

Mafee MF: Salivary glands. In: Mafee MF, Valvassori GE, Becker M (eds), Valvassori's Imaging of the Head and Neck, 2nd edn. Germany: Thieme, 8–61, 2012

McKean ME, Lee K, McGregor IA: The distribution of lymph nodes in and around the parotid gland: an anatomical study. Br J Plast Surg 38: 1–5, 1985

Marks NJ: The anatomy of the lymph nodes of the parotid gland. Clin Otolaryngol Allied Sci 9: 271–275, 1984

Mourouzis C, Boynton A, Grant J, Umar T, Wilson A, Macpheson D, et al: Cutaneous head and neck SCCs and risk of nodal metastasis – UK experience. J Craniomaxillofac Surg 37: 443–447. http://dx.doi.org/10.1016/j.jcms.2009.07.007, 2009

O'Brien CJ: The parotid gland as a metastatic basin for cutaneous cancer. Arch Otolaryngol Head Neck Surg 131: 551–555, 2005

Ollila DW, Foshag LJ, Essner R, Stern SL, Morton DL: Parotid region lymphatic mapping and sentinel lymphadenectomy for cutaneous melanoma. Ann Surg Oncol 6: 150–154, 1999

Picon AI, Coit DG, Shaha AR, Brady MS, Boyle JO, Singh BB, et al: Sentinel lymph node biopsy for cutaneous head and neck melanoma: mapping the parotid gland. Ann Surg Oncol 23. http://dx.doi.org/10.1245/ASO.2006.03.051, 2006 May

Pisani P, Ramponi A, Pia F: The deep parotid lymph nodes: an anatomical and oncological study. J Laryngol Otol 110: 148–150, 1996

Rodrigues DCA, Andreo JC, Menezes DFL, Chinellato PT, Rosa-Junior GM: Anatomy of the facial nerve and its implication in the surgical procedures. Int J Morphol 27: 183–186, 2009

Roarke MC, Ram P, Nguyen BD: Utility of SPECT/CT in preoperative planning for sentinel lymph node biopsy in melanoma and head/neck carcinoma: three illustrative cases. Clin Nucl Med 32: 464–465, 2007

Samra S, Sawh-Martinez R, Tom L, Colebunders B, Salameh B, Truini C, et al: A targeted approach to sentinel lymph node biopsies in the parotid region for head and neck melanomas. Ann Plast Surg 69: 415–417. http://dx.doi.org/10.1097/SAP.0b013e31824a21af, 2012

Santini H, Byers RM, Wolf PF: Melanoma metastatic to cervical and parotid nodes from an unknown primary site. Am J Surg 150: 510–512, 1985

Sarnavan K, Bapuraj JR, Sharma SC, Radotra BD, Khandelwal N, Suri S: Computed tomography and ultrasonographic evaluation of metastatic cervical lymph nodes with surgicoclinicopathologic correlation. J Laryngol Otol 116: 194–199, 2002

Shpitzer T, Gutman H, Barnea Y, Steinmetz A, Guttman D, Ad-El D, et al: Sentinel node-guided evaluation of drainage patterns for melanoma of the helix of the ear. Melanoma Res 17: 365–369, 2007

Stárek I, Koranda P, Zboøil V, Mrzena L: Sentinel lymph node biopsy in parotid gland carcinoma. Clin Nucl Med 31: 203–204, 2006

van Akkooi AC, Voit CA, Verhoef C, Eggermont AM: New developments in sentinel node staging in melanoma: controversies and alternatives. Curr Opin Oncol 22: 169–177. http://dx.doi.org/10.1097/CCO.0b013e328337aa78, 2010

van den Brekel MW, Castelijns JA: What the clinician wants to know: surgical perspective and ultrasound for lymph node imaging of the neck. Cancer Imaging 5(Spec No A): S41–S49, 2005 Nov 23

Vogl T, Bisdas S: Lymph node staging. Top Magn Reson Imaging 18: 303–316, 2007

Wells KE, Stadelmann WK, Rapaport DP, Hamlin R, Cruse CW, Reintgen D: Parotid selective lymphadenectomy in malignant melanoma. Ann Plast Surg 43: 1–6, 1999