

Technical Note
Head Neck Oncology

The use of carbon nanoparticles to track occult lingual lymph nodes in early-stage tongue squamous cell carcinoma

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Abstract. The lingual lymph nodes (LLNs) can only be detected with difficulty in early-stage tongue squamous cell carcinomas owing to the small size. Recurrence or metastasis could occur in the floor of the mouth as a result of neglecting the LLNs. The injection of carbon nanoparticles to track occult LLNs in early-stage tongue squamous cell carcinoma is presented and discussed. This technique is simple and easy to use intraoperatively. If LLNs were stained black during the operation, the sublingual gland along with the fatty tissue of the floor of the mouth were removed simultaneously. The LLNs in early-stage tongue squamous cell carcinoma deserve more attention.

Key words: Carbon Nanoparticles; Lingual Lymph Node; Tongue Squamous Cell Carcinoma.

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Several modifications of neck dissection have been proposed and elective neck dissection improves the prognosis in early-stage T1–T2 oral tongue squamous cell carcinoma¹. Nevertheless, lingual lymph nodes (LLNs) are not routinely removed in a neck dissection as they are not classified as conventional neck levels, especially for the early-stage carcinomas. LLNs are small lymph nodes located between a primary lingual

squamous cell carcinoma and the cervical lymph nodes, and can be classified as median and lateral LLNs². The LLNs were detected in five of 21 (23.8%) cadavers according to an anatomic–histologic study³. LLN metastasis in patients with tongue squamous cell carcinoma has been reported sporadically in the literature^{2,4,5}. Moreover, the mean length of LLN was 4.1 mm and the mean thickness was 2.8 mm, which was difficult to detect³.

According to Ananian et al.³, 11 cases with positive LLNs were reported in the English literature, and very few cases have been reported recently. Despite the low incidence of positive LLNs, recurrence or metastasis could occur in the floor of the mouth as a result of neglecting the LLNs.

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Several methods were reported to detect sentinel lymph nodes in conventional neck levels. Sentinel lymph node biopsy using computed tomographic lymphography⁶ or lymphoscintigraphy⁷ with technetium-99m was reported for tongue squamous cell carcinomas. In the area of head and neck oncology, carbon nanoparticles, as one of the tracers, were applied to track lymph nodes in papillary thyroid carcinoma^{8,9}. Herein, the novel utility of carbon nanoparticles to track occult LLNs in early-stage tongue squamous cell carcinoma is presented and discussed.

Materials and methods

Before the primary tumor resection, approximately 1 ml (1 ml:50 mg) carbon nanoparticles suspension (Lummy Pharmaceutical Co, Ltd, Chongqing, China) was injected into the tongue surrounding the primary tumor using a 1-ml syringe and avoiding intravascular injection. After 5–10 min, the lymphatic ducts and the lymph nodes were stained black (Figs 1 and 2). An

elective neck dissection and glossectomy were performed in the patient with early-stage tongue squamous cell carcinoma. If LLNs were stained black during the operation, the sublingual gland along with the fatty tissue of the floor of the mouth were removed simultaneously. Conversely, positive lymph nodes can be stained in level I, II and III. Histological analysis was performed for the primary tumor and the neck nodes.

Discussion

The N classification is an important risk factor for tongue squamous cell carcinoma. Common imaging including computed tomography and magnetic resonance imaging can detect the lymph nodes in conventional neck levels. However, these imaging techniques can hardly detect the small LLNs even when positive in early-stage tongue squamous cell carcinomas. Recurrence or metastasis could occur in the floor of the mouth if an occult LLN was neglected. Carbon nanoparticles are

used as LLNs tracer, which make the lymphatic system and the positive lymph nodes obviously stained. The sensitivity and specificity of lymph nodes detection in papillary thyroid carcinoma were 76–78.8% and 25–100%^{8–10}. However, the results of these trials showed more metastatic and total lymph nodes detected in the carbon nanoparticles group than the control group. As the average diameter of carbon nanoparticles is 150 nm, these particles pass through the lymphatic system and accumulate in the lymph nodes long enough to be identified during surgery^{8–10}. Moreover, carbon nanoparticles cause no toxic side effects in the human body^{8–10}. Importantly, this technique is simple and easy for surgeons during the operation. Carbon nanoparticles are significant for small occult lymph nodes, especially for LLNs in early-stage tongue squamous cell carcinoma, which are not routinely removed in a neck dissection. The LLNs in early-stage tongue squamous cell carcinoma deserve more attention owing to availability and the utility of tracers including carbon nanoparticles which are feasible and accurate technically.

Funding

None.

Competing Interests

None.

Ethical approval

Ethics approval was obtained by the Ethics Committee of Peking University School Hospital of Stomatology (PKUSSIRB-201840166).

Patient consent

Written informed consent was obtained from all patients.

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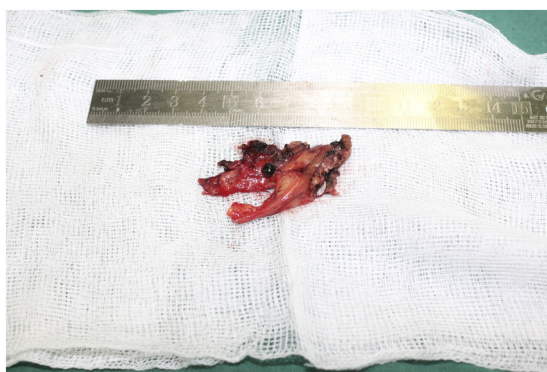


Fig. 1. A positive lingual lymph node surrounded by the sublingual gland and the fatty tissue of the floor of the mouth was stained black by carbon nanoparticles suspension injection in a patient with T2 tongue squamous cell carcinoma.

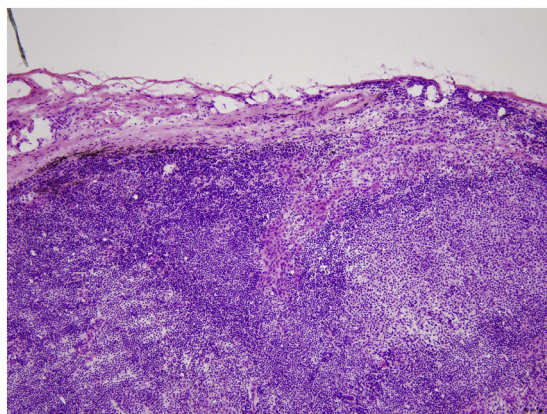


Fig. 2. Carbon nanoparticles were seen in the lymph node capsule and lymphatic vessels in the positive lingual lymph node (hematoxylin and eosin stain; $\times 100$).

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