Sentinel lymph node biopsy using a new indocyanine green fluorescence imaging system with a colour charged couple device camera for oral cancer

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Whether management of N0 neck in patients with oral cancer should be by observation or prophylactic neck dissection is controversial, as 20–30% of patients have occult cervical lymph node metastases.1 Accurate diagnosis of any metastasis is difficult despite the various imaging methods available, and consequently sentinel lymph node biopsy using blue dye, or a radioisotope, or both, has been used for these patients.1,2 However, biopsy is associated with several problems, including poor transcutaneous identification of the sentinel lymph nodes, high cost, the shine-through phenomenon, and exposure to radiation. Cost-effective indocyanine green (ICG) without radiation exposure has recently been used to detect sentinel nodes in patients with various cancers.3,4 Although ICG fluorescence imaging systems have advantages over conventional methods, identifying soft tissues such as muscles or nerves around the nodes is challenging on the monochromatic images produced. This requires surgeons to biopsy sentinel nodes under direct visualisation while also referring to the monochromatic images on the monitor. We report the use of a new ICG fluorescence imaging system that uses a colour charged couple device (CCD) camera for sentinel node biopsy in patients with oral cancer and will overcome these problems.

Preoperative computed tomographic lymphography was used to map the nodes three-dimensionally. To detect them intraoperatively we used the HyperEye Medical System (HEMS; Mizuho Ikakogyo Co., Ltd., Tokyo, Japan), which can visualise ICG-enhanced structures in vivid colour. An arm-type HEMS (USD 150,000) and a hand-type HEMS (USD 100,000) are available (Figs. 1 and 2). First, the mucosal surgical margin was marked with diathermy or laser in case with the mucosa changed colour after the injection. At each of 4 points around the oral lesion 20 mg/4 ml ICG 0.5–1 ml (Diagnogreen 0.5%; Daiichi Pharmaceutical, Tokyo, Japan) was injected. Several seconds later, the subcutaneous nodes could be seen transcutaneously with colour fluorescence imaging using the HEMS, because the ICG fluorescence can penetrate up to 1.5–2.0 cm.2 A skin incision 2–3 cm long was then made along the proposed incision line of the neck dissection. After incision of the skin and platysma muscle, the sentinel node could be biopsied easily, as it could be clearly identified under colour fluorescence imaging (Figs. 3 and 4). Although ICG-fluorescing nodes cannot always be detected transcutaneously if they are deep in the subcutaneous...
Fig. 1. Arm-type indocyanine green fluorescence imaging system: the HyperEye Medical System.

Fig. 2. Hand-type indocyanine green fluorescence imaging system: the HyperEye Medical System.

Fig. 3. Intraoperative view of sentinel lymph node biopsy.

Fig. 4. Colour and near-infrared images of sentinel lymph node biopsy.
tissue, nodes can be biopsied using ICG in such cases by mapping them preoperatively and then making the skin incision.

We biopsied sentinel nodes using the HEMS as described by Yamauchi et al. who showed the feasibility of the technique in animal models. As HEMS can simultaneously capture colour and near-infrared images, surgeons can easily identify surrounding anatomical structures such as nerves, vessels, and muscles as well as the nodes, because they are shown in vivid colour in the operative field. This new method has potential, but should be used in conjunction with radioisotopes until the problem of limited penetration of the fluorescence has been resolved by further study, and the accuracy of identification of subcutaneous nodes has been improved.

References