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Sentinel node biopsy in breast cancer using infrared laser system first experience with PDE camera

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ABSTRACT

Background: Sentinel node biopsy (SNB) is a gold standard in staging of early breast cancer. Nowadays, routine mapping of lymphatic tract is based on two tracers: human albumin with radioactive technetium, with or without blue dye. Recent years have seen a search for new tracers to examine sentinel node as well as lymphatic network. One of them is indocyanine green (ICG) visible in infrared light.
Aim: The aim of this study is to evaluate clinical usage of ICG in comparison with standard tracer, i.e. nanocoll, in SNB of breast cancer patients.
Materials and methods: In the 1st Department of Surgical Oncology and General Surgery, Greater Poland Cancer Centre, Poznań, 13 female breast cancer patients have benn operated since September 2010. All these patients had sentinel node biopsy with nanocoll (human albumin with radioactive technetium), and with indocyanine green. The feasibility of this new method was assessed in comparison with the standard nanocoll.
Results: A lymphatic network between the place of injection of ICG and sentinel node was seen in infrared light. An area where a sentinel node was possibly located was confirmed by gamma probe. Sensitivity of this method was 100%.
Conclusion: SNB using ICG is a new, promising diagnostics technique. This procedure is not without drawbacks; nevertheless it opens new horizons in lymphatic network diagnostics.

1. Background

Sentinel node biopsy (SNB) is a standard procedure in the staging of early breast cancer. On the one hand, it is an easy and safe way of providing information concerning the staging of a neoplastic disease and, on the other hand, it gives most patients a possibility to have the lymphatic system of the armpit spared.

As regards negative results of the SNB, randomised multicentre clinical research proved the absence of a significant difference in local relapses and survival rate between patients after resection and those with saved lymphatic system of the armpit.[1–3] The SNB provides benefits of much smaller incidence of complications and traumas as well as a better quality of life in comparison with axillary lymphadenectomy. At present, the standard procedure used in mapping lymph vessels and sentinel lymph node involves the application of

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tracers based on albumin marked with radioactive technetium in combination with or without blue dye. Either technique has its advantages and disadvantages. Originally, Guliano in breast cancer, just like Morton in skin melanoma, used blue dye to locate the sentinel node.[4,5] Later, Krag et al. used technetium sulphur colloid, which enabled transcutaneous identification of the sentinel node.[6] At present some centres use a radiocolloid by itself without blue dye. In recent years, there has been a search for an alternative method of visualisation of the lymph vessels and sentinel node. Indocyanine green is a promising tracer which, after being administered intradermally, flows to the sentinel node and is visible in infrared light also through the skin. The application of the method is at the stage of clinical research.

2. Aim

The aim of the study was to evaluate the usefulness of the new method of sentinel lymph node mapping in comparison with the radioactive technetium nanocolloid, which is a routinely used tracer.

3. Materials and methods

Since September 2010, 13 consecutive women with diagnosed breast cancer have undergone surgery in the 1st Department of Surgical Oncology and General Surgery, Greater Poland Cancer Centre, Poznań. The group of patients had an early breast cancer. Two of them had DCIS (ductal carcinoma in situ), 11 had invasive cancers (2 cases of T1a, 5 cases of T1b, 4 cases of T1c). In two cases, (both T1c) additional lymphadenectomy was done following intraoperative pathological examination of sentinel node because of metastases. The age of these patients ranged between 41 and 69.

A new system of sentinel node location was implemented in the patients. In order to visualise the sentinel lymph node, one day before the surgery the patients underwent a routine intradermal injection of radioactive technetium nanocolloid above the breast tumour. In the case of microcalcifications scattered over the whole breast, the tracer was administered periareolarly from four needle injections. The patients underwent lymphoscintigraphy. Immediately before the surgery, indocyanine green (ICG) (concentration 5 mg/ml, volume 1–2 ml) was also administered intradermally above the tumour, or periareolarly in the case of microcalcifications scattered over the whole breast. Then, after 5–10 min following the ICG injection, the lymph channels connecting the place of administration with the lymphatic system were visualised as along with the sentinel lymph node itself by means of a PDE (Photodynamic Eye) camera from Hamamatsu Photonics K.K., Hamamatsu, Japan (Fig. 1). The fluorescence phenomenon was used, which consists in the emission of light of appropriate wavelength from the substance which absorbs light of a different wavelength. The PDE camera emits infrared light with the wavelength of 760–805 nm and ICG exposed to the activity of that sends light radiation with the wavelength of about 820–830 nm. The sent light and emitted light are called excitation light (LED) and fluorescence light respectively. The image was seen in infrared light emitted

Fig. 1 – Place of injection of ICG intradermally above the breast cancer with two lymphatic channels passing to one sentinel node.

by the camera. CCD (charged coupled device) is a device that usually consists of three main components: an NIR (near-infrared) sensitive image intensifier, 16-bit dynamic-range frame transfer CCD camera, and light emitting diodes (LED). In comparison with the IC-View camera; Pulsion Medical Systems, Munich, Germany, which we used previously, the new system has more LEDs, which enables much better quality of obtained image and improved sensitivity of the examination. In each case, the ICG intercepted by the sentinel node was confirmed by means of a gamma probe of the camera routinely used for detection of gamma radiation transcutaneously during the SNB (Fig. 2), after opening the wound and once more after sentinel node resection.

4. Results

10 min after the administration of ICG in all patients, the PDE camera visualised the lymph ducts channels from the place of administration of the tracer with the lymphatic system of the armpit. In the place of atrophy of the lymph duct passage to

Fig. 2 – Lymphatic channels after ICG injection ending in the sentinel node-confirmed with the gamma probe.