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Radioactive seed localisation of non-palpable lymph nodes – A feasibility study

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ABSTRACT

Background: Radioactive seed localisation (RSL) is a preoperative localisation method using a small titanium seed containing iodine-125. The method is increasingly applied for localising non-palpable lesions in the treatment of breast cancer. We believe that RSL has the potential to be used in various surgical specialties. The aim of this feasibility study was to test RSL as a preoperative localisation of non-palpable lymph nodes.
Methods: Between November 24, 2015 and October 26, 2016, 15 patients with suspicious lymph nodes on imaging were included in the study. The lymph nodes were located in the axillary region (n = 9), the head and neck region (n = 5) and the inguinal region (n = 1). The seeds were placed in the centre of the lymph node, in the capsule or just outside the capsule guided by ultrasound. During surgery, incision and localisation of the lymph nodes were performed based on the auditory signal of the gamma probe. After excision, lymph nodes including iodine seeds were sent for pathologic examination and the seeds were returned to the Department of Nuclear Medicine.
Results: The non-palpable lymph nodes were all successfully marked using ultrasound. The lymph nodes were successfully localised and excised during surgery, and the procedure was performed without complications in the majority of the cases.
Conclusion: Localisation of suspicious non-palpable lymph nodes using RSL is feasible. RSL may ease the surgical procedure, minimise trauma to the surrounding tissue and ultimately benefit the patient. Future prospective studies are necessary to determine the further use of RSL within different surgical specialties.

Introduction

The comprehensive use of anatomical and functional imaging modalities has led to an increased number of detected non-palpable lesions including suspicious lymph nodes. Lymph nodes identified on imaging are often small and non-palpable. This makes it difficult to localise and differentiate them from normal tissue during surgery without preoperative localisation.

Different methods of preoperative localisation exist and include tracer injection with Technetium-99 (99 mTc)/radio guided occult lesion localisation (ROLL), wire-guided localisation (WGL) and intraoperative ultrasound guidance (IOUS) [1]. ROLL and WGL both have restricted flexibility in the scheduling of the procedures and technical difficulties have been described for both methods [2]. Intraoperative ultrasound requires a surgeon with experience in ultrasound examination.

Radioactive seed localisation (RSL) is a relatively new method of preoperative localisation involving a small titanium seed containing radioactive iodine (I-125). The method was introduced in breast surgery in 2001 and has gained ground due to an increasing number of non-palpable breast lesions identified through mammographic screening programs [3,4]. The iodine seed is

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preoperatively placed in the centre of the suspicious lesion guided by ultrasound or mammography. The non-palpable lesion is then localised during surgery with a handheld gamma probe [5].

In our institution, RSL has been tested in a large randomised trial where the aim was to compare the rate of positive resection margins between RSL and WGL in breast conserving surgery [6]. The experience from this trial has prompted us to investigate further use of the method. We believe that RSL has the potential to be used in various surgical specialties as preoperative localisation of suspicious, non-palpable lesions. RSL may overcome some of the limitations of the existing methods and ease the surgical identification of the lesion. However, only a limited number of studies have been published on the use of RSL outside breast surgery and the evidence is sparse.

Accordingly, the aim of this study was to test the feasibility of RSL of suspicious non-palpable lymph nodes within Otorhinolaryngology/Head and Neck Surgery, Plastic Surgery and Breast Surgery.

Methods

Patients

15 patients with suspicious non-palpable lymph nodes and no primary tumour site present, referred to the Department of Otorhinolaryngology/Head and Neck Surgery, Plastic Surgery or Breast Surgery, were identified in the outpatient clinic and asked to participate (five patients in each department, Table 1). The inclusion criteria were: a suspicious lymph node in the axillary, inguinal or head and neck region, visible on ultrasound, accessible for marking and in accordance with the lymph node seen on PET/CT, CT or mammography. Exclusion criteria were: patients not capable of understanding the information, pregnant or breast-feeding patients, patients under the age of 18 years.

Patients were given comprehensive oral and written information about the study, and if they decided to participate, an informed consent was signed. Permission was obtained from the National Committee on Health Research Ethics. Record No. H-I-2013-066 and approved by the Danish Medicine and Health Authorities and the Danish Data Protection Agency.

Procedures

I-125 seed placement: The seeds consisted of I-125 encapsulated by titanium and measure 4.5 × 0.8 mm. Seeds used in the study had an activity between 0.8 and 4.7 MBq. Two different kinds of seeds were used in the study: separate seeds (BARD Brachytherapy, INC. Carol Stream, IL, USA) and prepacked seeds (Intra-Medical Imaging, Hawthorne, CA, USA).

The marking of the lymph nodes was performed either on the day of surgery or the day before at the Department of Radiology. Separate seeds (BARD) were placed in an 18-gauge needle (CP Medical, Inc., Portland, OR) with bone wax occluding the tip to keep the iodine seed fixed until placement. A stilette was then carefully inserted without advancing it completely. The needle was introduced under ultrasound guidance, and the stilette was advanced completely to place the iodine seed in the centre of the lymph node, in the capsule or just outside the capsule. In patients in Head and Neck Surgery, the iodine seed was placed just outside the capsule to avoid capsule rupture. Deployment of the seed in the tissue was confirmed with a handheld gamma probe (Neo-2000; Johnson and Johnson, Ethicon Endo-surgery, Cincinnati, OH). This probe is also used in the sentinel node procedure. Radiologists, experienced with the procedure, performed the ultrasound-guided placement. The administration of iodine seeds in our institution has been described previously [7].

Surgery: The handheld gamma probe was used to localise the iodine seed during surgery. The transdermal auditory signal of the probe guided the localisation of the incision, and the lymph node including the iodine seed was excised. The surgeon confirmed that both lymph node and iodine seed were removed correctly as activity was detected only in the surgical specimen and not in the resection bed. The iodine seeds were sent to the Department of Pathology in either separate bags or located in the lymph nodes.

Pathologic examination: The pathologic examination was performed according to standard procedures. The iodine seeds, located in the lymph nodes, were identified with a gamma probe if not visualised immediately. The iodine seeds were removed and returned to the Department of Nuclear Medicine.

Outcomes

The primary outcome was identification rate of lymph nodes suspicious on imaging.

Secondary outcomes were duration of the surgical procedure, defined as time from skin incision to the end of surgery, and complication rate. Assessment of complications was done from the time of surgery until the postoperative visit at the outpatient clinic and included infection, hematoma, seroma and wound rupture.

Results

Patients were included between November 24, 2015 and October 26, 2016. Characteristics of the included patients are outlined in Table 1. The median age was 57 years, (range: 38–81).

Preoperatively, 73% (n = 11) of the patients had a Positron Emission Tomography/Computed Tomography (PET/CT) scan performed. The suspicious lymph nodes in all of the 11 patients were PET positive. The remaining 4 patients had their suspicious lymph nodes detected on either CT (n = 3) or diagnostic mammography (n = 1). Four of the patients had inconclusive biopsies performed prior to surgery, further details regarding the indication for the open diagnostic lymph node biopsy are described in Table 1.

The operative findings and definitive pathology of the lymph nodes are outlined in Table 2. The iodine seeds were placed in the centre of the lymph node, in the capsule or just outside the capsule in 12 patients. In three patients the iodine seed had been placed in the tissue surrounding the lymph node, which complicated the identification during surgery, but all suspicious lymph nodes were successfully identified and excised. The mean duration of the surgical procedures was 75 min. However, five of the procedures had prolonged duration due to more widespread pathologic tissue than expected preoperatively (n = 3), frozen section microscopy (n = 1) or ultrasound examination to verify that the excised lymph node was the correct one, as the iodine seed had been placed in the surrounding tissue (n = 1). In the majority of patients only the marked node was removed at surgery. An additional lymph node was removed in five of the patients due to suspicious characteristics. In four patients more tissue than the lymph nodes was removed due to extensive disease. After pathologic examination seven lymph nodes were diagnosed as reactive, two as benign and the remaining six lymph nodes contained metastasis from either ductal or lobular carcinoma, squamous cell carcinoma or malignant melanoma. All iodine seeds were identified during gross examination and returned to the Department of Nuclear Medicine.

Postoperative complications were only observed in one of the 15 patients, where the patient developed a moderate hematoma seven days after surgery. Surgical evacuation was not performed due to the size of the hematoma and a planned inguinal lymph node dissection.

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