Clinical application of ROLL technique in non-breast diseases. Complementary use after PET-CT study

Servicio de Medicina Nuclear, Complejo Hospitalario Universitario de Badajoz, Badajoz, Spain

Objective: The aim of this study was to evaluate the usefulness of ROLL technique (Radioguided Occult Lesion Localization) as a verification method of suspicious lesions not related to breast disease found in PET-CT studies.

Materials and methods: We retrospectively evaluated nine patients diagnosed of cancer or with suspected tumor disease who showed hypermetabolic lymph nodes in 18F-FDG PET-CT. Subjects underwent diagnostic testing for evaluation of treatment response in lymphoma (3), suspected recurrence in other tumors (3) or biopsy guide (3). The study group consisted of 4 women and 5 men, age range 25–72 years. ROLL technique was performed in surgically accessible lesions (supraclavicular region, lateral cervical, axillary and inguinal) with an intralesional injection of 99mTc-albumin macroaggregates guided by ultrasound the day before surgery. A scintigraphic study confirmed the focal tracer deposit and absence of skin contamination. During surgery, a gamma probe and portable gamma camera were used to locate lymph nodes.

Results: Surgical localization of radiolabeled lymph nodes was achieved in all cases with minimally invasive surgery and few postoperative complications. Histological study resulted in five tumor involvement (3 lymphoma, 1 germ cell tumor and 1 neuroendocrine carcinoma) and confirmed the existence of four false-positives in PET-CT study (1 sarcoidosis and 3 reactive follicular hyperplasia).

Conclusion: The ROLL technique proved to be a useful and relatively simple method for the study of no breast lesions suspicious of malignancy in PET-CT study.

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Aplicación clínica de la técnica ROLL en patología no mamaria. Uso complementario tras estudio PET-TAC

Objetivo: El objetivo del estudio fue valorar la utilidad de la técnica Radioguided Occult Lesion Localization (ROLL) como método de localización y extirpación de lesiones no mamarias sospechosas de malignidad halladas en estudios PET-TAC.

Material y métodos: Se valoraron de manera retrospectiva 9 pacientes oncológicos o con sospecha de patología neoplásica que presentaban adenopatías hipermetabólicas en estudio PET-TAC con 18F-FDG. Los sujetos fueron sometidos a la prueba diagnóstica para valoración de respuesta a tratamiento del linfoma (3), sospecha de recidiva en otros tumores (3) o guía de biopsia (3). El grupo estaba constituido por 4 mujeres y 5 hombres, con rango de edad entre 25–72 años. Se realizó la técnica ROLL en lesiones accesibles quirúrgicamente (región supraclavicular, laterocervical, axilar e inguinal) mediante inyección guiada por ecografía de 99mTc-macroagregados de albúmina el día previo a la cirugía. Un estudio gammagráfico confirmó el depósito focal del trazador y la ausencia de contaminación en piel. En el acto quirúrgico se utilizaron sonda gamma así como gammacámara portátil para localizar la adenopatía marcada.

Resultados: En todos los casos se consiguió la localización quirúrgica de las adenopatías radiomarcadas mediante cirugía mínimamente invasiva y escasas complicaciones posquirúrgicas. El estudio histológico dio como resultado 5 afectaciones tumorales (3 por linfoma, una por tumor germinal y una por carcinoma neuroendocrino) y permitió confirmar la existencia de 4 falsos positivos del estudio PET-TAC (una sarcoidosis y 3 hiperplasias foliculares reactivas).

Conclusión: La técnica ROLL probó ser un método útil y relativamente sencillo para el estudio de lesiones no mamarias sospechosas de malignidad en estudio PET-TAC.

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Introduction

Since the first reports on the use of radioguided surgery this technique has undergone great growth thanks to the development of selective lymph node biopsy in different tumors. In this context the Radioguided Occult Lesion Localization (ROLL) technique is widely used for the localization of non-palpable breast lesions, thereby replacing the use of the harpoon. The success of this new method has led to its application in non-breast diseases such as in the case of differentiated thyroid cancer.

The use of PET-CT is currently considered a comprehensive part of the management of oncologic patients, with $^{18}$F-FDG mainly being used as the marker of tumor viability.

This study may be used as a guide during biopsy for suspicion of neoplastic disease. Although the development of hybrid images has significantly improved the specificity of the test, it continues to present false positive cases. Indeed, antineoplastic treatments may be the cause of the increase of radiotracer uptake by non-tumoral tissues.

Fine needle aspiration puncture (FNAP) or thick needle biopsy (TNB) allow evaluation of suspicious lesions. Nonetheless, the material obtained may not be sufficient or the method may have scarce diagnostic value due to the presence of numerous reactive cells and few neoplastic cells in the lesion, thereby making excisional biopsy the first option.

Radioguided surgery and particularly the ROLL technique may play an important role, allowing confirmation of the findings observed in the metabolic study. The aim of this study was to assess the utility of this technique as a radioguided excisional biopsy method for hypermetabolic lesions suspected of malignancy found in PET-CT studies.

Materials and methods

Over a period of 21 months (from January 2014 to October 2013) we retrospectively evaluated nine oncologic patients suspected of having neoplastic disease and who had undergone PET-CT in which hypermetabolic adenopathies with a high probability of malignancy were observed. Although other patients had been proposed for undergoing the surgical technique, in view of the radioisotopic findings, only these nine patients were finally considered for the study. The group was made up of four women and five men ranging in age from 25 to 72 years. Three patients were diagnosed with lymphoma and the test was performed to assess treatment response. Another three presented suspicion of a neoplastic process and the PET-CT was indicated for staging and to guide biopsy. The last three patients had a history of neoplastic involvement (colon cancer, breast cancer and germinal tumor) and suspicion of tumor recurrence.

A hybrid Discovery ST (GE Medical Systems) was used for the whole body PET-CT studies. The acquisition was performed in 3D, 3 min per bed 60 min after the administration of $^{18}$F-FDG (5 MBq per kg of body weight). In view of the presence of adenopathies with elevated glycidic activity, histologic study was proposed in those with better surgical access and greater metabolic activity (Fig. 1). Neither FNAP or TNB was considered in any case, with excisional biopsy of the lesions being preferred.

The ROLL technique was carried out in the patients for localization and resection of the adenopathies selected within 2–4 weeks after the PET-CT study. The day prior to the surgery an ultrasound-guided injection of a dose of 37 MBq of $^{99m}$Tc-albumin macroaggregates was made in the center of the lesion at a volume of 0.1 mL. A planar scintigraphic study performed immediately afterwards confirmed focal radiotracer deposition and the absence of contamination on the skin. All the patients provided informed consent to participate in the study.

In all the cases the ROLL technique was performed by minimally invasive surgery and under general anesthesia. A Europrobe® and a portable Minicam® gamma camera were used during surgery, both of which had a cadmium telluride detector. The adenopathies resected were localized in the supraclavicular and bilateral axillary, left laterocervical and left inguinal regions. After confirming the absence of residual activity in the surgical field the adenopathies were sent for histologic and immunohistochemical study.

Results

Few post-surgical complications were presented following the technique (one keloid and one local infection of a suture point). The average surgical time was 30 min (range: 23–36 min), with localization and resection of the radiolabeled adenopathies in all the cases.

The histologic study of the lesions showed five tumors: three lymphomas, one germinal tumor and one neuroendocrine carcinoma. Likewise, the technique confirmed the presence of four false positive results in the PET-CT study; three reactive follicular hyperplasias and one granulomatous process.

Patients were followed for at least 6 months after having undergone the ROLL technique. Patient outcomes were evaluated by clinical examination, tumor markers and a new PET-CT study, except in the patient diagnosed with a granulomatous process who underwent clinical and radiological examination and blood analysis. The five patients with confirmed neoplastic involvement underwent chemotherapy treatment, with normalization of tumor markers, clinical manifestations and complete metabolic response. The patient diagnosed with metastasis of neuroendocrine cancer died. The three patients presenting reactive follicular hyperplasias did not present clinical manifestations of recurrence or tumor, and the control PET-CT was negative. Lastly, the patient diagnosed with granulomatous disease was treated with corticosteroids and showed adequate response.

Table 1 shows the clinical and diagnostic characteristics of the patients and the findings of the isotopic study and surgery as well as the outcome of the nine patients studied.

Discussion

PET is currently considered one of the most widely used imaging techniques for the diagnosis and follow-up of oncologic patients. Its use as a guide during biopsy is well recognized since it can demonstrate the presence of tumoral tissue before morphological changes become evident. The images obtained allow localization of the most representative and accessible hypermetabolic lesions, thereby facilitating their histologic study and adequate staging of the process.

Nevertheless, $^{18}$F-FDG accumulates in benign lesions with elevated glycidic metabolism behaving as false positive results and thus, reducing the specificity of the technique. For example, in up to 30% of the patients diagnosed with Hodgkin’s lymphoma false positive results have been described in PET studies performed after two chemotherapy cycles.

On the other hand, the presence of hypermetabolic lesions after treatment does not rule out the presence of residual neoplastic activity or the lack of response to this treatment. All of this may lead to unnecessary studies or treatments in the patient.

Radioguided surgery allows intraoperative identification of lesions labeled with radioactive isotopes. The main applications of this procedure in oncology are the identification of the sentinel lymph node in different tumors and the localization of occult lesions. This latter application may be carried out with intravenous
administration of a radiotracer such as $^{18}$F-FDG$^{10}$ which accumulates in the tumoral tissue or can be injected into the lesion as occurs in the ROLL technique.$^{11}$

Since the first description of this technique by Luini et al. in occult breast cancer in 1997, the advantages of the use of the harpoon have been described, including reduced excision volume, a high percentage of free surgical margins and better esthetic results.$^{12,13}$ Some years ago ROLL began to be used as a surgical technique in non-breast tumor diseases such as in the case of cervical recurrence of differentiated thyroid cancer previously confirmed by FNAP.$^{2,14}$ Several authors have reported good results with its use as a technique of rescue surgery after the PET-CT study, with some studies also being done after previous confirmation with FNAP.$^{10,15}$ In other studies the ROLL technique has been satisfactorily applied as an excisional biopsy method for diagnostic purposes.$^{6,16}$

Our results coincide with the last authors. The persistence of neoplastic activity after treatment was confirmed in a patient with lymphoma, the diagnosis of this disease in two patients and the presence of tumoral recurrence in two of the three patients in whom this was suspected. On the other hand, the technique showed four false positive results in the metabolic study, thereby avoiding the need to perform other complementary tests or administer unnecessary treatments.

Scintigraphic imaging prior to surgery allows testing the technical quality of the injection and the absence of contamination.
on the skin. In our case, a SPECT-CT study was not necessary since the PET-CT images were used as the anatomical guide for surgery.

With the use of $^{99m}$Tc, surgery to be carried out the day after the injection. The absence of background noise during surgery facilitated both the localization of the radiotracer and confirmation of complete resection. This all contributed to achieving a short mean surgical procedure time, effectiveness in lesion findings in all the cases, minimum radiation to the patient and scarce post-surgical complications.

Nonetheless, the technique presents some limitations. In patients with multiple lesions it is difficult to perform excisional biopsy in all of the lesions and thus, histologically confirm their etiology. In our case this disadvantage did not occur since the adenopathy selected in each patient was shown to be adequate as demonstrated by the clinical outcome and the posterior metabolic studies.

Another possible inconvenience is the lack of accessibility of the lesion to be studied, impeding puncture. In this case a radioguided surgical probe was used for positron emitters and $^{18}$F-FDG was used as the radiotracer, taking into account the problems derived from radioprotection and the need to perform the study immediately before surgery due to the limited half life of this radioisotope.

Conclusions

The ROLL technique was found to be a useful, inexpensive and relatively simple method for the study of non-breast lesions suspected of malignancy and for the management of oncological patients in PET-CT studies.

Conflict of interests

The authors declare no conflict of interest.

References


