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Original article

CT-guided fine-needle aspiration of abdominal and retroperitoneal small lesions with the coaxial technique using MPR images

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Summary. *Purpose:* To demonstrate the advantages of CT-guided fine-needle aspiration (FNA) of abdominal and retroperitoneal small lesions with the coaxial technique using MPR images. *Materials and methods:* The study included retrospectively 50 patients who underwent CT-guided FNA of abdominal and/or retroperitoneal small lesion (<30 mm). Patients with suspected lymphomas or sarcomas were excluded. Cytology reports were the reference standard. *Results:* The cytology was diagnostic in 48/50 biopsies (96%): out of 41 neoplastic lesions (85%), 37 were malignant (90.2%) and 4 were benign (9.8%); 7 out of 48 were non-neoplastic (14.6%). No procedural complications were observed (0%). *Conclusion:* By using MPR images there is an effective improvement in coaxial CT-guided FNA of abdominal and retroperitoneal small lesions. (www.actabiomedica.it)

Key words: CT-guided fine needle aspiration; coaxial technique; MPR images

1. Introduction

Diagnostic imaging plays a pivotal role in the pre-therapeutic evaluation of neoplasm, in the detection of tumours as well as in the cytological and histological characterization through imaging-guided biopsies. Indeed, cytological and/or histological features of neoplasm are useful in the decision of the most effective therapy to be followed; therefore, such features are mandatory in the management of oncologic patients. (1) Nowadays, a frequently mini-invasive approach used to obtain tumoral tissue is represented by percutaneous biopsies, namely the fine-needle aspiration (FNA) (2, 3). Both ultrasound (US) and multi-detector computed tomography (MDCT) are used as guide for FNA procedures; while US allows the real-time evaluation of the course of the needle and is not associated to ionizing radiations (4-8), MDCT is very helpful in the detection of small lesions and of neoplasm that are located in anatomic sites that are difficult to evaluate with US, although the Patients is exposed to ionizing radiations (9-11). Through MDCT and its Multiplanar Reconstructions (MPR), lesions located in anatomic sites that are considered of difficult access can be better evaluated and subsequently biopsied (12, 13); indeed, MPR images are helpful in the pre-operative assessment of the most useful course of the needles that are used for biopsies of thoracic, abdominal and retroperitoneal lesions (12-17). However, MPR images have not yet proved to be useful for carrying out abdominal and retroperitoneal CT-guided biopsies with coaxial technique (18).

The aim of this study was to demonstrate the advantages of using MPR images in FNA with CT-guided coaxial technique, for analysing abdominal and/or retroperitoneal small lesions which are impos-

sible to reach with conventional non-surgical biopsy techniques, particularly in cases in which the cytology sample was not possible to obtain by means of US or CT guide with axial images.

2. Materials and Methods

2.1 Patient Population

We retrospectively included in our study 50 patients (32 males, 18 females; age ranging from 44 to 72 years) that underwent CT-guided FNA of abdominal and/or retroperitoneal small lesions (size of the lesion between 7 and 30 mm) in the period from May 2013 to December 2015. The indication to the CT-guided FNA was represented by a lesion - previously detected trough radiologic investigations - that could not be biopsied through ultrasound or axial CT scans, mainly because of the interposition of intestinal bloating or of viscera, bones, vessels and nerves.

We excluded Patients with suspected lymphomas or sarcomas, because the equipment needed to make an accurate diagnosis cannot be bent; furthermore, paediatric patients and those with bleeding diathesis were excluded, too.

2.2 CT-guided FNA Technique

The patients' informed consent was obtained in all cases.

The procedures were all performed with a 6-detector helical scanner (Somatom Emotion 6, Siemens, Erlangen, Germany), without the administration of contrast media; the following technical parameters were used: 100 kV, 90 mAs, 2 mm collimation, 2.5 slice thickness with 1 mm of reconstruction increment. The multi-planar reformatted images were obtained through a dedicated software of a post-processing workstation (Leonardo, Siemens, Erlangen, Germany). All patients were biopsied with CT-guided FNA with coaxial technique, using MPR images for all cases.

The extemporaneous microscopic evaluation of the biopsy's samples was performed immediately after the procedure as the cytologist was present on site.

Although all examinations were performed without contrast media, peripheral venous access with a 20-Gauge cannula needle was obtained in case drugs were required.

One experienced radiologist (M.D.F.) with 10 years of experience in CT-guided pulmonary and abdominal biopsies performed the procedures.

Briefly, the patients were placed on the CT bed in various positions depending on the site of the lesion that should be biopsied; a centimetre wire mesh was fixed onto each patient's skin as a landmark. The first step was the acquisition of the axial scans, followed by the multi-planar reconstruction in order to decide the most adequate trajectory of the 18-Gauge guiding Chiba needle. The MPR images allowed avoiding anatomical obstacles such as bone, major vessels, nerves or parenchymal organs.

Once the stylet of the guide was removed, a second and smaller Chiba needle was introduced, namely a 22-Gauge needle.

A second CT scan and the respective MPR images allowed evaluating if the needle was in the correct position (i.e. within the lesion) and if position was adequate the cytological sample was taken; the pathologist could perform the qualitative and quantitative microscopic analysis directly on site.

To exclude any procedure-related complication, a third scan was obtained after the needle was removed; nevertheless, the patients were kept under clinical observation for 4 hours after the biopsy to perform laboratory and radiological tests in order to exclude major complications (active bleeding, organ lesions or perforations).

The cytology report was used as reference standard for assessing the accuracy of FNA.

2.3 Statistical Analysis

The overall diagnostic accuracy of CT-guided FNA of abdominal and/or retroperitoneal small lesions was calculated as: true positive (TP) + true negative (TN)/TP+TN+ false positive (FP) + false negative (FN) (19).

We evaluated the accuracy of the method concerning the suitability of the cytological test in Patients that could not undergo - because of the presence of

Table 1. Table reporting the cytological diagnosis after CT-guided coaxial biopsy technique (n: number of cases).

Cytological diagnosis (n)		n (%)
Malignant neoplasms (37)	Primary	9 (24.3)
	Metastasis	23 (62.1)
	Relapse	5 (13.5)
Benign neoplasms		4 (8)
Benign non-neoplastic lesions		7 (14)
Inadequate samples		2 (4)

various anatomical obstacles - the aspiration of small (size less than 30 mm) abdominal or retroperitoneal lesions by means of ultrasound or CT-guided FNA without MPR.

3. Results

50 CT-guided FNA with coaxial technique and multi-planar reconstructed images were performed (Table 1) (Figs. 1, 2, 3 and 4)).

The target lesions subjected to biopsy were divided as follows:

- 30 out of 50 cases (60%) were retroperitoneal solid lesions not involving lymph nodes;
- 9 out of 50 (18%) were intra-and retroperitoneal lymph node lesions or suspected secondary pelvic localization;
- 11 out of 50 cases (22%) were parenchymal lesions or involving hollow organs or muscles.

In all cases, the CT-guided biopsy technique coaxial with MPR images enabled us to detect the tip of the needle within the target lesion (100%).

The biological material was considered to be suitable for cytological study, with a diagnostic value, in 48 out of 50 biopsies (96%), so the sample was inadequate in 2 cases (4%).

Among these, 41 out of 48 (85.4%) were found to be neoplasms (Table 1), of which:

- 37/41 were malignant (90.2%); 9 were primary lesions (21.9%), 23 secondary lesions (56%) and 5 relapses (12.2%);
- 4/41 were benign neoplasms (9.8%);
- 7/48 were benign not neoplastic lesions (14.6%).

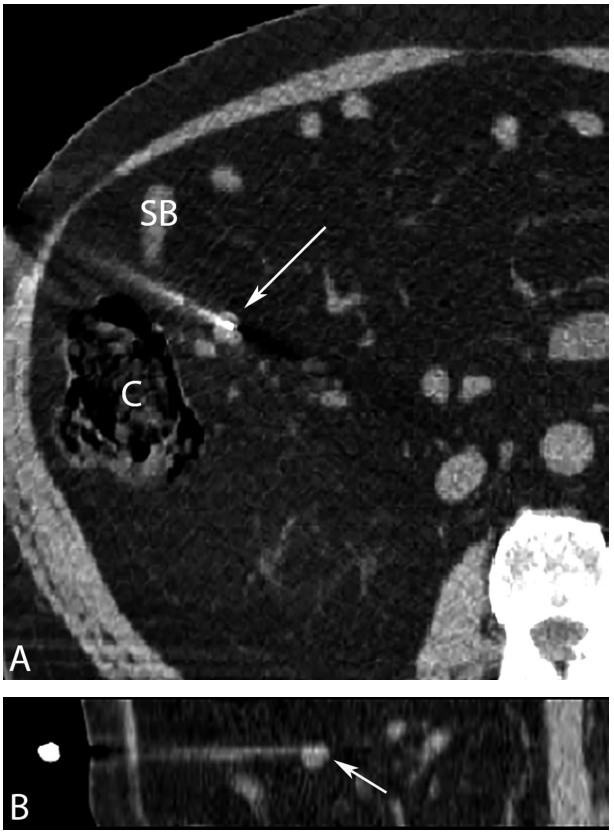

Figure 1. 49-year-old male with an outcome of right hemicolectomy (9 months) for intestinal adenocarcinoma.
The CT-guided FNA of a pericolic lymph node in the right iliac fossa (A, arrows) with a suspected FDG uptake in a previous PET-CT. The cytologic diagnosis was the metastasis of a previously-operated bowel carcinoma.
In this case, the coaxial technique was associated with MPR images (B, parasagittal plane) in order to avoid perforating the colon (C) and small bowel (SB).

The overall diagnostic accuracy of the method was 96% (48/50).

Procedural complications did not occur in any of the 50 cases (0%).

4. Discussion

The multi-planar reformatted images allowed collecting biological samples through CT-guided fine needle biopsies with coaxial technique in 100% of cases; the cytological diagnosis of abdominal or retroperitoneal small lesions was obtained in 96% of the

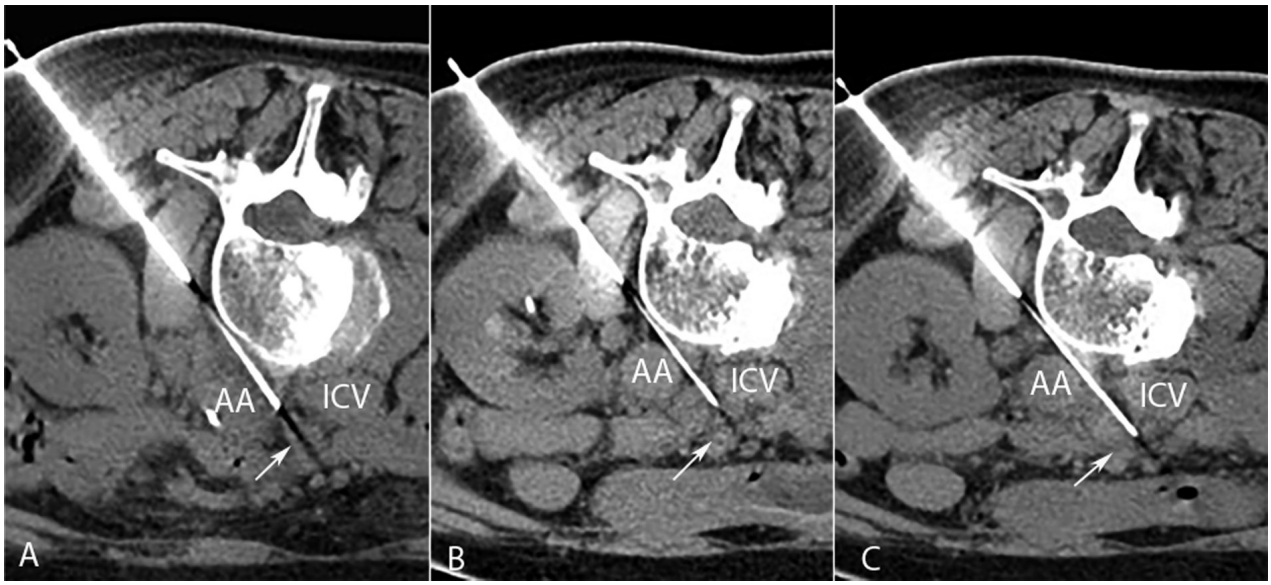

Figure 2. 75-year-old female with lymphadenopathies (arrows) between abdominal aorta (AA) and inferior caval vein (ICV) and massive mediastinal mass which suggested the diagnosis of lymphoproliferative disease. The result of the CT-guided FNA cytology samples lymph nodes between aorta and caval vein, showed the presence of inflammatory lymph nodes without neoplastic cells; the mediastinal mass was found to be a schwannoma.
CT-guided FNA in three different scanning planes, with coaxial technique with MPR images (oblique axial images), in order to avoid perforating the abdominal aorta and the inferior caval vein (patient in prone position).
A) FNA in a plane in which we observe an aortic wall calcification; B) FNA in a plane in which is present a little stone in the left kidney; C) FNA in a plane that does not include the aortic calcification or the kidney stone

cases, which could not otherwise be reached with non-surgical biopsies.

Our study population presented abdominal small lesions with suspected malignancy detected in previous radiological imaging; in such population, biopsies guided through ultrasound or CT-guided axial images were not possible, albeit US and MDCT are the most frequently used as a guide for percutaneous biopsies of suspected abdominal and retroperitoneal lesions (2-8). Ultrasound presents various advantages such as low costs, easy repeatability, real-time evaluation of the path of the needle and the absence of ionizing radiation (4). In case of small lesions - located deeply in the abdomen - and unreachable through US, CT-guided biopsy represents the best option to obtain tissue samples (9-11); moreover by using reformatted images it is possible to biopsy lesions that cannot be reached with axial CT images alone (12-17). Indeed, MPR images are nowadays commonly evaluated, in order to determine the safest trajectory of the needle (12-22).

To our knowledge, studies concerning the effectiveness of the coaxial technique using MPR images for CT-guided biopsies have not yet been carried out.

Our preliminary experience suggests that the advancement of CT-guided coaxial biopsy technique in abdominal/retroperitoneal small lesions can be successfully performed thanks to this association of methods and instruments.

Our study presents some limitations; the population was small and selected, including patients with small lesions that could not be biopsied through ultrasound guidance or with conventional CT guidance because of the hindrance represented by parenchymal organs, bones vascular and nervous structures.

We excluded patients with clinically and radiologically suspected lymphomas or sarcomas; for those neoplasms, unbendable cutting needles are needed to perform a biopsy; however, abdominal lymphomas and sarcomas, usually manifest themselves as lesions of dimension that are adequate to allow a needle biopsy procedure with US or conventional CT.

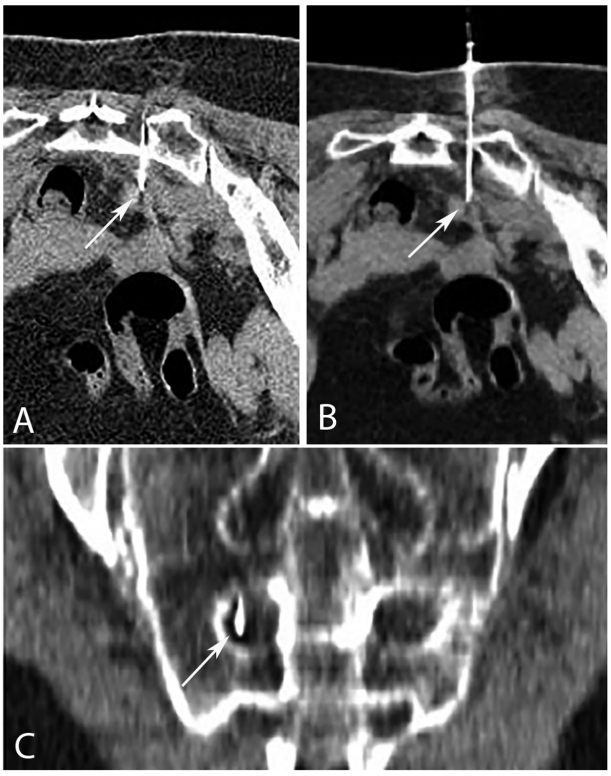

Figure 3. 64-year-old female with an outcome of anterior resection of the rectum (12 months) for rectal adenocarcinoma. CT-guided FNA performed with the patient in the prone position sampled a right presacral lymph node (arrows in B). In this case, the coaxial technique was associated with the use of MPR images (C, coronal plane) in order to introduce the needle inside a sacral right foramen and to avoid anatomical obstacles such as bowel in front and sacrum posteriorly. Cytology showed the presence of intestinal carcinoma cells inside the sampled lymph node.
A- Native axial plane; B- Oblique-axial MPR plane; C- MPR Coronal oblique plane

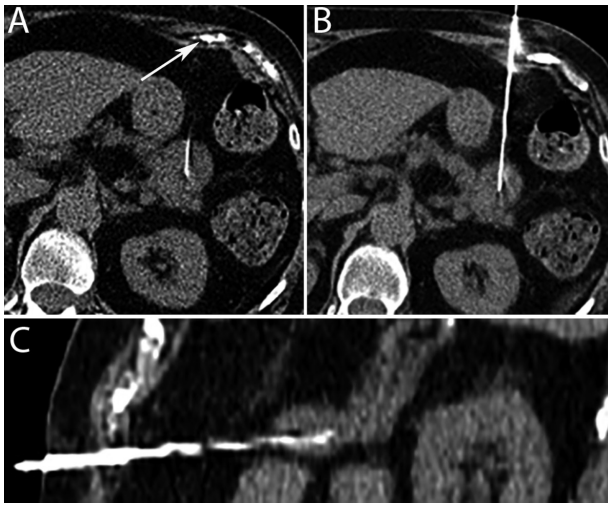

Figure 4. 57 years old female suffering from abdominal pain. FNA of the small mass of the pancreatic tail was positive for paraganglioma. In this case, the coaxial technique was associated with MPR images in order to avoid a left rib (arrow in A) and the perforation of the descending bowel and stomach (B and C).
A- Native axial plane; B- Oblique axial MPR plane; C- Oblique Sagittal MPR plane

5. Conclusions

The use of MPR images represents an advancement of effective co-axial CT-guided FNA of abdominal and retroperitoneal small lesions.

By using this technique it is possible to avoid carrying out surgical biopsies of small lesions that are difficult to reach under US or CT guidance with the conventional technique.

"All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards."

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