Abdom Imaging 19:217–220 (1994)

Abdominal Imaging

Dual-Angled CT-Guided Biopsy

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Received: April 15, 1993/Accepted: May 20, 1993

Abstract. A new computed tomographic (CT)-guided biopsy technique is described which employs angling both the CT-gantry and the patient to access lesions considered unapproachable using conventional CT techniques. Angling the gantry and the patient, or dual angulation, was applied in five patients with masses located in the pelvis and retroperitoneum that were not easily accessible using gantry angling or patient tilting alone. In each case, the needle tip was demonstrated in the lesion and diagnostic tissue was retrieved. No complications were recorded. A dual-angled approach defines a safe path to a mass and allows obtaining a CT image in the plane of the biopsy needle.

Key words: Biopsy, CT-guided—Angled gantry—Dual angle.

Computed tomography (CT), an established imaging modality for guiding percutaneous needle biopsy, enables the radiologist to plan a safe course for the needle from the skin surface to the target and to obtain a tissue sample. A conventional CT-guided biopsy technique generally relies on perpendicular CT gantry. Not all lesions can be approached in this way. Angulation of the needle using the triangulation method [1], and angling the gantry, have been discussed in the approach to these difficult lesions [2, 3]. Using the angled gantry approach, the biopsy needle is introduced at the same angle as that of the gantry to facilitate precision placement within the target [3]. For lesions in more difficult locations, however, angulation in both sagittal and axial planes may become necessary to avoid transgression of certain structures or to overcome obstacles to conventional CT biopsy technique (Fig. 1).

We describe a technique that uses both patient and gantry angulation to safely and easily biopsy lesions in certain difficult locations.

Methods and Patients

Five patients are described using the dual-angled approach. In each patient a conventional biopsy approach would have been difficult, hazardous, or impossible.

The procedures were monitored using 3-mm sections using a Siemens Somatom plus scanner, when possible, using spiral scanning mode [4]. The cephalic or caudal gantry angulations were defined relative to the position of the x-ray tube at the 12 o'clock position within the CT gantry. Standard biopsy needles (18–22 G) were used to obtain specimens. Number of needle passes were recorded. The success of the technique was judged by the ability to demonstrate the needle-tip within the lesion, and adequacy of the diagnostic material for cytological diagnosis and, where possible, with surgical and clinical follow-up.

Case Reports

Case 1

A 68-year-old man with prostate cancer was referred for biopsy of a 2-cm soft tissue mass between the left iliac vessels and sigmoid colon found on CT of the pelvis. Scanning in supine position showed that the lesion was shielded posteriorly by the iliac bone and the sacrum (Fig. 2A). An anterior biopsy approach was not feasible because of overlying bowel. The patient was placed in a prone oblique position with a 15° cephalic tilt of the CT gantry (Fig. 1). Using this positioning a simple needle path to the lesion was achieved (Fig. 2B). The tip of a 15-cm, 20-gauge needle was demonstrated within the lesion (Fig. 2C). Two needle passes were performed to obtain the specimen. The cytology specimen showed a benign lesion consistent with a schwannoma.

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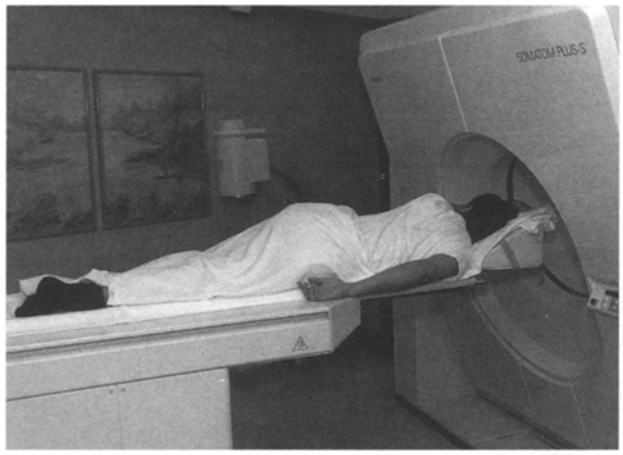

Fig. 1. Dual-angled positioning. Note the angulation of the CT gantry and obliquity of the patient.

Case 2

A 65-year-old man with no known primary malignancy presented with increasing back pain, anorexia, and weight loss. CT revealed enlarged lymph nodes posterior to the right renal hilum. On initial axial CT in the prone position, the renal vascular pedicle was seen close to the target lymph nodes. Twenty degrees of cephalic tilt of the CT gantry allowed the biopsy tract to be clear of the renal vessels thus avoiding a risk of transgression of the renal vascular pedicle. Introduction of the biopsy needle at this stage would require cephalic needle angulation along with the gantry tilt and an additional medial angle of the needle tip (Fig. 3A and B). Instead the patient was placed in the prone oblique position. This allowed imaging in the plane of the needle. A 15-cm, 22-gauge needle was placed into the target lymph nodes coaxially through a 10-cm, 18-gauge needle. One needle pass was used. The sample was positive for adenocarcinoma.

Case 3

A 60-year-old woman had a resection of tongue cancer in 1990. She presented with a 2-cm mass in the upper neck. Further workup with abdominal CT identified a 3-cm left adrenal mass and a biopsy was planned. An analysis of the CT images revealed that an anterior approach would pass through the pancreas and a posterior approach in the prone position would transgress the pleura. CT images in the prone position using a maximum tilt of 25° cephalad would still require transgressing the pleural space. Pillows were, therefore, placed under the patient's pelvis to increase effective cephalic angulation. The patient was then rolled from a prone to left anterior oblique prone position. With this positioning a window of needle approach from skin to the target was achieved. A 20-cm, 22-gauge needle was placed coaxially through a 15-cm, 18-gauge Chiba needle and two needle passes performed. Cytologic examination confirmed presence of benign adrenal adenoma. The patient subsequently underwent a right radical neck dissection for the neck mass. Abdominal surgery was avoided.

Case 4

A 70-year-old man had a pancreatic tail mass and multiple liver lesions. Biopsy of the pancreas and liver for staging was indicated. An anterior approach to the pancreas would have passed through the colon. CT in the supine position and a caudal gantry tilt of 15° still showed bowel in the needle path, except for a small space lateral to the mass. The patient was placed in the left anterior oblique position revealing a wider space to transgress into the mass. One needle pass was used. Two liver lesions were also biopsied using conventional CT technique. Both lesions contained adenocarcinoma.

Case 5

A 71-year-old woman with recurrent colonic carcinoma presented with a fever and a necrotic mass of recurrent cancer overlying the left ala of sacrum. Aspiration of the necrotic area was contemplated to exclude presence of infection. An anterior approach would transgress the gut and posterior approach was impossible because of overlying bone. Dual angulation with the patient in the prone oblique position and 15° cephalic angulation of the CT gantry aligned the target mass, left greater sciatic notch, and the skin entry site for a single-pass needle aspiration. The aspirate was sterile on culture.

Discussion

The aim of CT-guided biopsy is to obtain an image that contains the skin entry site, the needle path, and the lesion, and a later image to show the needle tip within the lesion. Visualization of the needle tip within the mass is facilitated by spiral scanning mode [4]. However, spiral scanning is not essential for CT-guided biopsy. In a majority of patients successful guidance can be achieved using axial CT. But in selected patients CT-guided biopsy will require angling the gantry. An angled CT gantry approach has been successfully used in the past in order to avoid transgression, of the pleura, for example, in aspiration of upper pole renal cyst in the prone position or of the liver edge for pancreatic biopsies [3]. CT guidance permits scrutiny of the structures that may be transgressed by the biopsy needle. The skin to lesion distance can be measured electronically on the CT console in order to facilitate choice of the needle.

There are, however, some patients who, on conventional axial CT or angled gantry, may not exhibit a safe and easy path between the skin and a lesion. In these patients, gantry angulation along with an axial angulation of a biopsy needle may become necessary. The gantry angulation can be easily reproduced by introducing the biopsy needle with the CT gantry localization light passing through the needle hub during insertion [5]. But exact axial angulation of the needle is difficult and may require repeated needle adjustment. This will prolong the procedure time and may increase chances of complications. In practice this problem is a real one, and commercially available precision angulation devices have become available, for example, the "Accuplace" disposable interventional biopsy needle guide (INRAD Inc., Grand Rapids, MI, USA). We did not use any such devices.

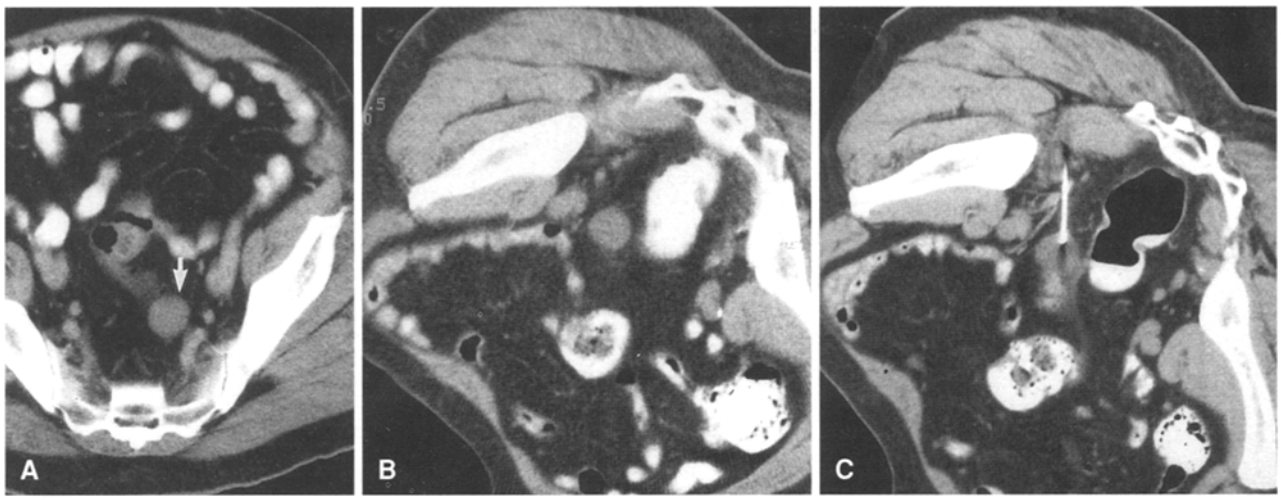

Fig. 2. *Case 1:* Dual-angled approach for a deep pelvic lesion. **A** Supine CT image of the pelvis, 2-cm soft tissue mass (*arrow*) deep in the pelvis. **B** Patient prone with 35° obliquity and a 15° cephalic tilt of CT gantry. The target and the greater sciatic notch are aligned with the overlying soft tissues. **C** Biopsy needle within the lesion.

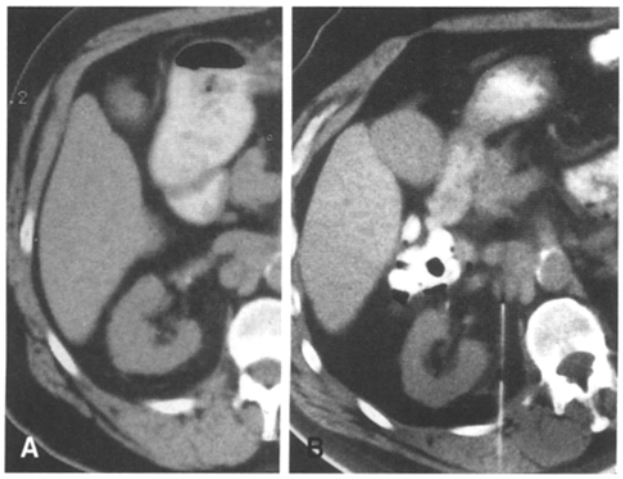

Fig. 3. *Case 2:* Dual-angled approach for a retroperitoneal lesion. **A** Supine CT image of the upper abdomen showing enlarged retrocaval lymph nodes at renal hilum. **B** Patient prone with 10° obliquity and 20° cephalic tilt of the CT gantry shows the needle path clear of the renal blood vessels.

Also, a complex needle approach consisting of both sagittal and axial angulation may become necessary while performing biopsy of a high retroperitoneal lesion close to the midline or a pelvic mass. The sagittal angle can be easily negotiated by advancing the needle along the gantry localization light as described above.

But the need for axial needle angulation and its attended difficulty can be eliminated by substituting the required angle with patient obliquity (Fig. 1). This would greatly simplify needle placement. To our knowledge, obliquity of the patient to eliminate axial needle angulation has not been described before. We used the method of angling both the gantry and the patient as our five cases demonstrate. Using this dual-angled approach, we have successfully been able to circumvent the pleural space (case 3), bowel (cases 1, 4, and 5), pancreas (case 3), bone (cases 1 and 5), and vascular structures (case 2).

There is some risk of pneumothorax when attempting biopsies of adrenal glands, upper poles of the kidneys, from posterior approach, or liver lesions near the dome of the diaphragm [6, 7]. Cephalic angulation of the gantry for biopsy in prone position minimizes chances of pleural transgression. The risk of pancreatitis after percutaneous biopsy of left adrenal masses by anterior, transpancreatic, approach has been reported at 6% [8]. Two of the 33 patients in one series required 11–13 days of hospitalization for acute pancreatitis. Biopsy of a mass within the pancreas, itself, however, carries a 3% risk of pancreatitis [9]. Clearly, risk of pancreatitis following left adrenal biopsy can be eliminated if the pancreas is not transgressed. We used such an approach in case 3 to biopsy a mass in the left adrenal gland.

In our case 1, an anterior approach would transgress the bowel and mesentery. A posterior approach would be impossible with a straight gantry due to overlying bone. But a gantry angulation combined with appropriate patient obliquity, eliminating need for axial needle angulation, greatly simplified the approach by aligning the target lesion with the greater sciatic notch (Fig. 2). A similar plan has been used in other patients in order to eliminate or reduce the risk of transgression of important structures. When the cephalic or caudal needle angle required is greater than the maximum gantry an-

gulation, then pillows can be placed under the patient to increase the effective angle of biopsy needle.

In conclusion, patient obliquity and CT gantry angulation can be usefully employed to safely and easily biopsy lesions that may be difficult or impossible to approach using conventional CT guidance. We feel that transgression of the pancreas to biopsy a left adrenal mass is only justified if attempts to use dual-angled approach fails.

Acknowledgment. This work was supported in part by USPHS grant CA 09536.

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