Flow-Augmentation Device for Peripheral Vascular Doppler US

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To augment venous blood flow at Doppler ultrasonography (US) of the extremities, a device comprising a blood pressure cuff connected to an external reservoir was tested. Constant and easily controlled pressure was delivered with each compression by the same operator performing US. In 10 patients (four men and six women, aged 54–86 years), discomfort was reduced compared with discomfort during manual compression, which requires two operators.

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At Doppler ultrasonography (US) of the peripheral circulation, slow flow is often undetectable and is indistinguishable from absence of flow. To differentiate between slow flow and echo-poor thrombus, compression or flow augmentation maneuvers are usually performed (1,2).

The compression maneuver, which is performed to demonstrate the compliance of patent vessels, is not entirely without complications. Focal pressure applied to a thrombosed vessel may dislodge thrombus (3).

The augmentation maneuver consists of gently squeezing the limb distal to the level of the Doppler examination so blood is forced through the venous system and patency can be demonstrated. The augmentation maneuver is effective but cumbersome: It requires the presence of a second operator, the degree of compression is not well controlled, and focal pressure applied by hand to a limb that is tender causes considerable discomfort.

The device described herein helps reduce or eliminate these problems since it allows the augmentation maneuver to be performed by a single operator, delivers more constant and better-controlled pressure, is intrinsically safer than manual compression because it distributes the pressure over a wider area, and helps reduce patient discomfort.

The augmentation device comprises a blood pressure cuff connected to an external reservoir with a flexible tube (Fig 1). The cuff is applied loosely to the limb in the usual fashion at a level distal to that of the Doppler examination (Fig 2). When the cuff is deflated, only a negligible pressure is applied to the limb. When air is pumped into the cuff-bag system, the pressure to the limb is still negligible because most of the air accumulates in the very compliant external bag. When the bag is squeezed, the air quickly transfers into the blood pressure cuff. When the bag is released, the air rapidly leaves the blood pressure cuff and reaccumulates in the bag. Flow augmentation is produced by squeezing the bag with a brisk and gentle compression. The bag can be squeezed by hand or can be placed on the floor and squeezed with a foot. In this case the operator has both hands free to perform US scanning. The pressure is evenly distributed over a large surface so the focal pressure is reduced.

The device was tested in the US examination of 10 patients (four men and six women, aged 54–86 years) seen from March through June 1991 to rule out deep venous thrombosis in the lower extremities. Verbal consent was obtained from each patient. The compression maneuver was performed by hand and with the device. The patients were asked which procedure caused less discomfort. No attempt was made to quantify the degree of discomfort. In all cases augmentation with the blood pressure cuff caused less discomfort than did
The device does not require the use of specialized parts and can be used with components readily available in any radiology department. The external reservoir is the same size as the bag of the blood pressure cuff and contains approximately the same amount of air. The bag should be squeezed completely during the augmentation maneuver so that approximately the same amount of air is displaced each time. Operation of the device can be improved by using custom-made parts, such as a foot pump for accurate control of the degree of compression and of a wider cuff than is used with manual compression to reduce the pressure to the limb while efficient flow augmentation is maintained.

References

Laser Guidance System for CT-guided Procedures

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In a phantom and in 37 patients, a simple laser guidance system for computed tomography (CT)-guided procedures used the software program of the CT scanner and a laser beam mounted on the gantry without need for additional software or components. The skin entry point and angulation of the target path were determined. Then the system projected the desired needle path (including compound angulation), allowing accurate needle placement in all cases, even in small lesions.

Index terms: Biopsies, technology • Computed tomography (CT) guidance

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Computed tomography (CT)-guided procedures are well established. When CT-guided procedures for the body are performed with free-hand guidance, localization of a needle within even relatively large lesions can necessitate multiple needle manipulations (2). Use of the free-hand method, which is inaccurate and time-consuming, is tolerable for abdominal biopsies, but for lung biopsies or percutaneous needle localization of pulmonary nodules (3–5), repeated puncturing of the pleura increases the risk of pneumothorax (6).

Many guidance systems have been developed for biopsy of the chest and abdomen. The most simple system is a disposable device that does not allow compound angulation (7). Others are stereotactic systems that allow compound angulation of the biopsy path (8,9) but that necessitate use of other components mounted in the scanning room (9) and/or of additional software (8,9). Light guidance systems have already been described (10,11) that necessitate use of other components mounted in the scanning room (11) and/or additional software (10,11).

We describe a simple light guidance system that makes use of a laser beam mounted on the CT gantry and of the software program provided by the manufacturer of the CT scanner, without the need for use of any additional software or component.

Materials and Methods

A protractor was mounted on a horizontal rail affixed to the top of the gantry (Elite Plus CT scanner; Elscint, Arlington Heights, Ill) (Fig 1) and was designed to slide along the length of the rail. The protractor supported a laser beam (Biophoton, Toulouse, France) that rotated about the center of the protractor, always remaining in the plane of the gantry. The rotation of the laser beam could be adjusted to the nearest 1° angle.

Once the gantry was tilted, the device moved with it, allowing compound angulation of the biopsy path. The device can be adapted for use on any CT scanner. To achieve a lateral approach to a biopsy target, the device can be mounted on a vertical rail affixed to the side of the gantry (Fig 2).

The patient was placed on the CT table, and transaxial images were obtained at the level of the lesion. The point of entry on the skin and the target point in the tissue were chosen. The computer software was used to connect these points and to display the length of the biopsy path and the angle of incidence to the vertical of this path (Fig 3). The angle of incidence to the horizontal of this path was chosen instead when the system was mounted on the vertical rail for lateral approaches.

The point of entry was located on the skin, and a radiopaque marker was placed. A transaxial image was obtained of the section, and the point of entry was marked on the patient's skin. The table top with the patient on it was moved under the device, out of the scanning plane. The laser beam was inclined to match the angle of incidence to the vertical of the chosen target path, and the protractor supporting the laser beam was moved along the rail until the laser beam was coincident with the skin entry point.

The needle or biopsy instrument was inserted superficially into the point of entry and angulated in such a way that the laser beam was projected on its top (Fig 1).