Noninvasive Assessment of Upper Extremity Deep Venous Obstructions

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Introduction

Deep venous thrombosis (DVT) of the upper extremity is relatively uncommon, with a reported incidence of only 1-2% of all DVT. With the increasing use of central venous lines, Swan Ganz catheters, and long-dwelling chemotherapy and hyperalimentation lines, upper extremity venous thrombosis may be increasing and presents to the Vascular Laboratory additional demands for accurate non-invasive diagnosis.

Phleborheography (PRG) and Doppler ultrasound are widely accepted noninvasive techniques used in diagnosing deep venous obstruction of the lower extremities with an accuracy rate of 95-98% for PRG and 93-96% for Doppler ultrasound. This paper will describe our experience with these two techniques in the diagnosis of DVT of the upper extremity.

Materials and Methods

Twenty-one patients with a clinical diagnosis of upper extremity DVT were studied. The most common presenting sign was edema, which was present in 95% of the patients. Pain ranging from aching to severe localized pain was present in 57%. Less common signs included prominent venous patterns over the arm, shoulder or chest, coldness, numbness, inflammation, mottling, cyanosis and motor impairment. Both arms were evaluated in each of the 21 patients with PRG and Doppler ultrasound. In addition, 8 asymptomatic volunteers with normal upper extremities were studied with the same noninvasive tests.

The patients were studied supine with the head of the bed elevated 30° and the arms loosely at the sides. In order to achieve optimum results, the amount of flexion and rotation at the elbow and the shoulder was altered. PRG was performed as described by Cranley for the lower extremity, by placing cuffs at the level of the wrist, forearm and upper arm. Recordings were made at rest and also with compressions of 50 mm. of Hg. at the wrist and forearm. The Doppler ultrasound examination was performed by listening at the radial, ulnar, brachial, axillary, cephalic and subclavian veins in both arms.

A normal PRG of the lower extremity demonstrates respiratory waves with breathing and the absence of baseline elevation with foot and calf compression. Respiratory waves reflect an increase and decrease in the volume of the leg due to changes in intra-abdominal pressure. A baseline elevation is caused by the increase in volume resulting from the damming up of blood distal to an obstruction during compression of the limb.

We applied similar criteria in evaluating our upper extremity PRG’s. The volume of the upper extremity is related to alterations in intra-thoracic rather than intra-abdominal pressure. Accordingly, with inspiration intrathoracic pressure decreases, thereby augmenting venous return from the arms and resulting in a decrease in arm volume. With expiration there is an increase in limb volume as the increase in intra-thoracic pressure results in an impairment of venous return from the arm. Overall, the presence or absence of respiratory waves was not a very reliable measure for determining deep venous obstruction, since these waves were present to some degree in all of the upper extremity PRG’s. A comparison of the respiratory waves in the arms showed a poorer quality wave on the affected side in 36% of the PRG’s. The presence or absence of baseline elevations with wrist and forearm compression, proved to be an accurate abnormal finding.

The criteria used to evaluate upper extremity venous patency using Doppler ultrasound were similar to that used for the lower extremity. Patency was determined by noting the phasic respiratory variation of flow and its augmentation using compression maneuvers. These findings were present in all patients subsequently proven by venography to have patent deep veins of the upper extremity, as well as in all 16 upper extremities of normal volunteers. Pulsatile flow was a prominent feature of Doppler ultrasound evaluation and was frequently observed with only minimal phasic variation. These findings are not unexpected considering the proximity of the major veins of the upper extremity to the right atrium and the small number of valves between the veins examined and the heart. The most reliable sign of
abnormality in the upper extremity was a continuous, high-pitched flow. This sign has been described for the lower extremity and was found in all of the venogram-proven obstructions of the upper extremity. The absence or reduction of venous flow response to compression maneuvers was not as consistent a finding, noted in only 70% of the patients with proven DVT.

Results

Venography was performed on 13 limbs evaluated by PRG and Doppler ultrasound. The PRG was correct in 11 cases, having a sensitivity of 85% and a specificity of 100%. Our results using Doppler ultrasound correlated with venography in all cases, giving a sensitivity and specificity of 100%. One false-negative PRG was in a patient with no deep venous thrombosis, but with extrinsic compression of the subclavian vein by the pectoralis minor tendon. The second false-negative was in a patient with prominent, long-standing collaterals about an occluded axillary and subclavian vein. This patient was correctly diagnosed by Doppler ultrasound because of the presence of high-pitched, continuous flow in these collateral channels.

Summary

In conclusion, we feel that phleborheography and Doppler ultrasound are useful measures for diagnosing upper extremity deep venous thrombosis. Although the number of patients with obstruction confirmed by venography is small, these results to date suggest that the accuracy rates for these two tests in the upper extremity will approach the accuracy rates obtained in the lower extremity. We are encouraged by these results and recommend their use in diagnosing upper extremity deep venous obstruction.

References