Superior Vena Caval System Obstruction Caused by Benign Endothoracic Goiter

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The superior vena caval syndrome caused by a substernal thyroid is a rare occurrence. It can, however, result from external compression of the superior vena cava or innominate veins by an intrathoracic goiter. This report details such a case in which innominate vein occlusion was documented both by conventional venography and by a new technique utilizing a radionuclide (sodium pertechnetate 99mTc) and the scintillation camera.

Superior vena caval syndrome caused by a benign endothoracic goiter is a rare occurrence.¹ We wish to present such a case wherein compression and obstruction of the right innominate vein was documented both by conventional venography and a recently described² technique using a radionuclide (sodium pertechnetate 99mTc) and the scintillation camera.

CASE REPORT

A 58-year-old woman was admitted to Michael Reese Hospital, March 8, 1968, complaining of swelling of her face and arms. One year prior to admission she had been notified that a routine mobile survey chest x-ray picture was abnormal. Subsequently, she noted progressive swelling of her face and arms, dilated veins on her chest, and dyspnea when supine or in the left lateral decubitus position. She denied any difficulty in swallowing. Approximately two weeks before seeking admission to the hospital, her voice had become hoarse.

Physical examination at the time of admission revealed an obese middle-aged woman with plethoric facies, brawny edema of the arms and marked swelling of the soft tissues of the neck, especially at the supraclavicular areas. There was a prominent venous pattern on the upper chest. The blood pressure was 190/110 and 180/100 mm Hg in the right and left arms, respectively. The thyroid was multinodular, symmetrically enlarged, and extended beneath the sternum.

The palpable portion of the gland was estimated to be about three times normal size. Breath sounds were decreased at the base of the right lung; no motion of the right hemidiaphragm was detected. Normal movements of the vocal cords were demonstrated on indirect laryngoscopic examination.

Admission chest x-ray picture revealed an anterior mediastinal mass and discoid atelectasis at the right base (Fig 1). There was no motion of the right hemidiaphragm demonstrable at fluoroscopy. Mediastinal tomograms revealed a smooth, homogeneous anterior mediastinal mass, without calcifications, extending downward from the neck and narrowing the trachea (Fig 2). There was a significant decrease in the width of the trachea with the Mueller maneuver, indicating tracheomalacia. A radioiodine thyroid scan

Figure 1. Chest x-ray picture demonstrating (anterior) mediastinal mass, tracheal deviation and right basilar discoid atelectasis.

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The scintillation camera employed in the present study has been described in detail elsewhere. In addition, the instrument is now equipped with a 70 mm stop-motion camera replacing the conventional viewing port. This camera utilizes an electronic film advance permitting accurate exposures ranging from one second to 20 minutes.

The supine patient was positioned under the 11.5-inch camera crystal so that the entire precordium and a significant portion of the lung fields were located in the crystal field of view. Thirty mc 99m Tc was administered intravenously in a “concentrated” bolus as previously described. At the time of release of the blood pressure cuff (ie, the time of entry of the bolus), the 70 mm camera was activated and a 99m Tc point-source marker was momentarily inserted into the field of view of the camera to record on film the time of initiation of the study. The film was electronically advanced every second for approximately 30 seconds.

The preoperative scintillation camera 99m Tc blood flow studies are depicted in Figure 5. The initial study was performed five days prior to surgery through use of a right antecubital vein injection. At 2 sec postinjection, there is marked retention of radionuclide in the distal right subclavian and proximal right innominate veins, and collateral venous blood flow is seen in the cervical area. At 3 sec, a further increase in radioactivity in cervical collateral veins is seen; in addition, there is now some flow through a markedly narrowed right innominate vein. At 4 sec, the superior vena cava is visualized; there is also collateral venous blood flow from the neck into the superior vena cava as well as collateral filling of the left innominate vein. Displacement of the superior vena cava to the right is evident in the 4 to 7 sec films. Filling of the right atrium and ventricle is seen at 5 to 6 sec and the pulmonary outflow tract is visualized at 6 to 7 sec. However, retention of radionuclide in the superior vena cava is evident throughout the study.

A second preoperative scintillation camera study with the use of a left antecubital vein injection was performed one day prior to surgery. Marked displacement of the left innominate vein as well as narrowing of its origin from the left subclavian vein are clearly evident. In contrast to the

Figure 2. Mediastinal tomogram demonstrating homogeneous anterior mediastinal mass extending downward from the neck and narrowing the trachea.

Figure 3. Thyroid 131I scan demonstrating subternal extension of large asymmetrical goiter with spotty radiiodine uptake (SN = suprasternal notch).

Figure 4. Superior vena cavagram demonstrating almost complete obstruction of right innominate vein, marked compression of left innominate vein at its origin, and displacement of the superior vena cava to the right. Note filling of collateral neck and chest vessels.

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Figure 5. Preoperative scintillation camera $^{99m}$Te blood flow studies. Study on March 14, 1968, performed with right antecubital injection: study on March 18, 1968 performed with left antecubital injection. RSV = right, left subclavian vein; RIV = right, left innominate vein; SVC = superior vena cava; RA = right atrium; RV = right ventricle; PA = pulmonary artery. Unlabeled arrows in 2 and 3 sec films in study of March 14, 1968, indicate cerebral collateral venous blood flow. Unlabeled arrows in 2 and 3 sec films in study of March 18, 1968 indicate narrowing of proximal left innominate vein. Note retrograde flow from left innominate vein in 2 and 3 sec films (for full description see text).

The patient was discharged from hospital on the seventh postoperative day. One month later there had been considerable reduction in swelling of soft tissue of the face, neck and arms. The final scintillation camera blood flow study was performed with simultaneous injections of the right and left antecubital veins (Fig 6). Although the right innominate vein is patent, filling of this vessel is not clearly evident until 4 sec. Residual displacement of the left innominate vein is evident at 2 to 3 sec. Right-sided cervical collateral venous circulation persists (3 to 4 sec).

On May 2, 1968, the patient was re-admitted to the hospital critically ill following the acute onset of chills, fever and dyspnea. She suffered a fatal cardiac arrest four hours after admission. Postmortem examination revealed obstructive mucopurulent tracheobronchitis with diffuse atelectasis of both lungs. The innominate veins and superior vena cava were patent. The remainder of the left lobe of the thyroid weighed 95 gm.

Discussion

Obstruction of the superior vena cava causes an easily recognized clinical syndrome which is characterized by cyanosis, edema of the head, neck and upper extremities and a prominent venous pattern on the chest wall. The same syndrome is found in bilateral innominate vein obstruction or arteriovenous fistula between the superior vena cava and the ascending aorta. Superior vena caval obstruction may result from external compression, usually by tumor or inflammation or from internal occlusion of the vessel by tumor, inflammation or thrombosis.

Benign intrathoracic tumors causing superior vena caval obstruction are distinctly unusual. McIntire and Sykes' in their extensive review of 250 published cases of obstruction of the superior vena cava appearing in the literature from 1904 through 1945, reported benign thoracic tumors as the etiology in only three cases (1.2 percent). They compared this to an incidence of 4 percent in
Fisher's earlier series. The three cases collected by McIntire and Sykes included a dermoid cyst, an unverified case which radiographically may have represented a dermoid cyst or goiter, and a hyper-thyroid patient in whom a thymic tumor caused the obstruction. Most series reported since that time have not included substernal goiter as the etiologic basis of the superior vena caval obstruction. Indeed, in 733 cases of superior vena caval obstruction reported since 1949, as reviewed by Kamiya and associates, only nine were caused by benign intrathoracic tumors. Included among these were two cases of caval obstruction caused by intrathoracic goiter seen at the Cleveland Clinic and the two additional instances where substernal thyroid was presumed to be the etiologic factor.

Intrathoracic goiter is itself a relatively uncommon condition, the incidence in series of thyroidectomies ranging from 1 percent to 10 percent. Among nodose goiters at autopsy, 0.25 percent have been found to be intrathoracic. Dilatation of neck veins is not often noted in the presence of intrathoracic goiter and when it occurs it is usually caused by pressure on the jugular veins. Higgins has indicated, however, that in such cases obstruction of the superior vena cava may occasionally occur. Recently, a superior vena cava compression syndrome was reported in 1/10 cases of mediastinal goiter. Rarely, thyroid carcinoma may extend to the great vessels and cause the superior vena caval syndrome.

The scintillation camera has been used in our laboratory for dynamic studies of cardiopulmonary blood flow with sodium pertechnetate. The technique has been found of value in determining relative cardiac chamber size, detection of intracardiac shunts, demonstration of pericardial effusions, and, as illustrated here, in the diagnosis of the superior vena caval syndrome. Delineation of intrathoracic venous obstruction with this technique compares favorably with that obtained with conventional venography, and in the presence of malignancy serial studies have been of value in characterizing response to radiation therapy. In the patient reported here, improvement in intrathoracic venous blood flow following thyroidectomy was readily documented by serial postoperative radionuclide studies.

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