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Chronic Venous Insufficiency: Assessment with Descending Venography[1]

Six hundred forty-four legs were examined by means of descending venography in patients with chronic venous insufficiency. Three patient positions (supine, 30° semierect, and 60° semierect) were used with a standard angiographic technique. Patients were also studied during either normal respiration or a Valsalva maneuver. The deep venous valvular system was incompetent more often than the superficial (saphenous) venous system. Positive venograms revealed that reflux occurred into the deep venous system alone in 82%, the superficial venous system alone in only 2%, and a combination of deep and superficial systems in 16%. The authors conclude that descending venography is best performed at the more physiologic 60° semierect position and with the Valsalva maneuver, which enables evaluation of the competence of valves in the closed position.

Index terms: Extremities, blood supply, 93.753 • Veins, abnormalities, 93.759 • Veins, extremities, 93.124, 93.9 • Venography, 93.124

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RECENT advances in surgical treatment of chronic venous insufficiency, such as valve repair, have made anatomic and functional evaluation of the venous valves in the lower extremities crucial. Descending venography is important in assessment of these patients (1,2). It not only shows exactly the location of the valves in the leg veins but also demonstrates the competence or incompetence of these valves. With the data obtained from these examinations, a more informed decision regarding the course of treatment on these patients can be made.

Other methods of evaluating the venous system are frequently used and provide complementary information. Noninvasive studies serve an excellent screening function but are limited in that they do not permit accurate localization of the levels of the valve stations and specific identification of incompetent segments. Ascending venography allows definition of the anatomy of the venous system, but it cannot provide an assessment of venous valvular incompetence. Descending venography remains the definitive test for identifying incompetent valves (1).

Herein, we report our series of 644 lower extremities evaluated with descending venography. To our knowledge this represents the largest series of descending venograms ever reported.

MATERIALS AND METHODS

A total of 644 lower extremities were evaluated with descending venography at our institution from April 10, 1979, through June 7, 1988. Among these 644 lower extremities, 480 (74%) were examined as part of bilateral examinations on the same day. Unilateral examinations of the right leg accounted for 94 (14%) studies, and unilateral examinations of the left leg accounted for 70 (11%) of the examinations. Three hundred seventy-eight (59%) of the extremities examined were those of women; 266 (41%) were those of men. All patients had clinical signs and symptoms of chronic venous stasis disease, including edema, skin discoloration, induration, aching pain, and/or ulceration.

All extremities were evaluated with ascending venography, usually on the day before descending venography. The ascending venogram allowed for more complete visualization of the venous anatomy of the leg, including demonstration of anatomic variants, acute deep venous thrombosis, and chronic changes such as occlusions or recanalizations from prior phlebitis. In some patients the ascending venogram revealed changes, such as extensive venous occlusions, that were believed to account for the cause of their clinical presentation. In these patients appropriate medical or surgical therapy could be planned, and a descending venogram was not necessary. However, if the cause of the patient's problems was not confidently identified on the basis of the ascending venogram, descending venography was performed to evaluate valvular competence.

The technique for performing descending venography was as follows: With use of standard angiographic technique, a 6-F end-hole catheter with one or two distal side holes was positioned at the junction of the external iliac vein and common femoral vein. If a unilateral examination was to be performed, the catheter was placed from the ipsilateral femoral vein approach. If a bilateral examination was to be done, both legs were studied from a single femoral vein puncture so as to avoid the additional patient discomfort of a second femoral puncture. Whenever satisfactory catheter position could not be achieved from the contralateral femoral puncture site, bilateral femoral vein punctures became necessary.

Under fluoroscopic observation, diatrizoate meglumine (Hypaque 60%; Winthrop Pharmaceuticals, New York) was slowly injected by hand at an estimated rate of approximately 50–75 mL/min. The volume of contrast material needed to evaluate an extremity varied with the findings. In a normal extremity with no reflux, 30 mL usually sufficed. In extremities with reflux, a larger volume of contrast material was needed, but this volume seldom exceeded 100 mL. Both spot films and videotape were used to provide permanent documentation of the findings.

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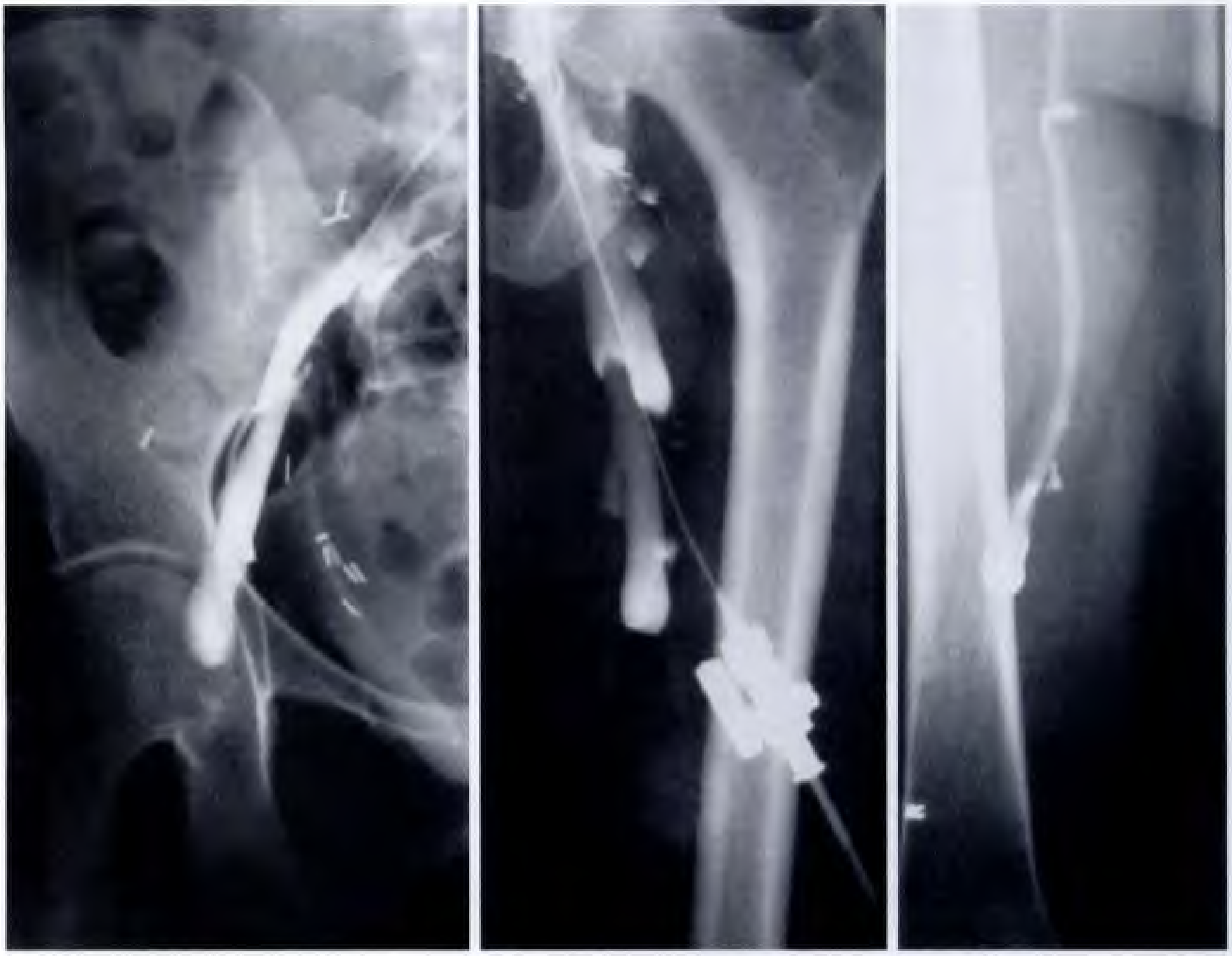

1. 2. 3.

Figures 1–3. **(1)** Grade 0 (valvular competence). No significant contrast reflux appears below the common femoral vein. **(2)** Grade 1 (minimal valvular incompetence). Reflux appears beyond the uppermost valves but not below the upper thigh. **(3)** Grade 2 (mild valvular incompetence). Reflux appears in the superficial femoral vein and extends to the distal or lower thigh level above the knee.

During the course of our series, four slightly different techniques or variations were used at injection of contrast material. In the first 243 legs that were studied, the patients were elevated into a 60° semierect position. The patient's weight was borne by a block placed under the contralateral foot so that the leg being evaluated was relaxed and bore no weight. Instillation of contrast material was first performed with the patient breathing normally and then repeated while the patient was instructed to bear down in a Valsalva maneuver.

The second technique was used in the evaluation of the next 232 legs. In this second method, the patients were elevated to a 60° semierect position, and contrast material was injected with patients both breathing normally and performing a Valsalva maneuver in a manner similar to the previous method. However, in these same patients, both the normal respiration and the Valsalva portions of the procedure were repeated with the patients elevated to only 30° of head elevation.

The third variation was used in the next 82 legs. In this method, the patients were examined in the supine position. Contrast material was not injected during normal respiration but was injected only during a standardized Valsalva maneuver. The syringe barrel of a 10-mL syringe was connected to the tubing on a mercury-column blood pressure manometer. Each patient was instructed to blow into this syringe hub so as to elevate the mercury column to the 40-mm mark and maintain the mercury column at this level. This technique was used to provide a more standardized or controlled Valsalva maneuver because some patients seemed to have difficulty in understanding the instructions to bear down.

Finally, the last 87 legs were examined with the technique we came to favor. These patients were elevated to a 60° semierect position with weight borne on the contralateral leg. Contrast material injection was performed with the standardized Valsalva maneuver described above.

In the interpretation of the descending venograms, the specific veins that were abnormal and demonstrated valvular incompetence were identified. Specifically, indications were made as to whether reflux did or did not occur into the superficial femoral vein, deep femoral vein, saphenous vein, and/or popliteal vein. In addition, the extent of contrast material reflux was considered important and was graded according to a classification system based on that employed by Kistner et al (1) and Herman et al (2). Grade 0 indicated valvular competence with no signif-

Figure 4. Grade 3 (moderate valvular incompetence). Reflux extends to a level just below the knee.

icant contrast material reflux below the common femoral vein (Fig 1). Grade 1 indicated minimal valvular incompetence with reflux beyond the uppermost valves but not below the upper thigh (Fig 2). Grade 2, mild incompetence, indicated reflux to the distal or lower thigh level, but above the knee (Fig 3). Grade 3, moderate incompetence, indicated reflux to the level of the knee or just below the knee (Fig 4). Grade 4, severe incompetence, indicated reflux into the calf veins, often to the level of the ankle.

RESULTS

There was no reflux (grade 0) in 159 (25%) of the legs examined. In 485 (75%) legs there was reflux of grade 1 or greater. Of the 485 examinations that demonstrated reflux, only 11 (2%) of these examinations demonstrated reflux into the saphenous vein only and only 88 (18%) demonstrated reflux into the saphenous vein either alone or in combination with reflux into the deep femoral vein, superficial femoral vein, or both. Examinations of the remaining 397 (82%) legs were positive for reflux into the superficial femoral vein and/or deep femoral vein systems. Two hundred forty-seven (51%) of the 485 legs with positive examinations had reflux into both the deep femoral vein and superficial femoral vein; this was the most common single pattern of reflux in our study. Ninety-four (19%) of the 485 legs demonstrated reflux into the superficial femoral vein system alone. Fifty-six (12%) of the 485 legs showed reflux into the deep femoral vein alone.

A total of 240 bilateral examinations were performed. Of these 240 patients, 161 (67%) demonstrated bilateral reflux. Fifty-three (22%) of these patients demonstrated unilateral reflux. In only 26 (11%) of these patients no reflux was demonstrated within either leg.

In 191 (39%) of the 485 positive examinations, reflux was restricted to the thigh (grades 1 and 2). One hundred five (22%) of the 485 legs that demonstrated reflux showed reflux to the level of the knee (grade 3). Reflux was present in the calf veins (grade 4) in 189 (39%) of the legs with positive examinations.

A total of 475 legs were examined both during normal respiration and during a Valsalva maneuver. Two hundred fifty-four (53%) of these legs showed no significant change in the extent or characterization of the reflux with normal respiration compared with the Valsalva maneuver. However, 214 (45%) of these legs did show a significant increase in the degree of reflux with a Valsalva maneuver that would have altered the grading classification. Only 7 (1%) demonstrated an increase in reflux with normal respiration that would have altered the grading classification.

A total of 232 legs were examined with the patients in 30° and 60° semierect angulations. In 137 (59%) of these legs, no significant change in the degree of reflux was identified. However, in 95 (41%) of the legs there was a significant increase in the amount of reflux at 60° compared with 30°. This increase in reflux would have been sufficient to alter the grading classification. In no legs was a significant increase in reflux seen at 30° compared with 60°.

When evaluating the four different techniques used to perform these studies, we made the following observation. Of the first 243 legs, examined at 60° head elevation with both normal respiration and a Valsalva maneuver, 57 (23%) demonstrated no reflux. Of the next 232 legs, examined at both 30° head elevation and 60° head elevation and with both normal respiration and a Valsalva maneuver, 40 (17%) demonstrated no reflux. Of the next 82 legs, examined with the supine technique with a standardized Valsalva maneuver, 48 (58%) showed no reflux. Of the final 87 legs, examined at 60° head elevation and with a standardized Valsalva maneuver, 14 (16%) showed no reflux.

DISCUSSION

Chronic venous stasis disease is caused by insufficiency or incompetence of the venous valvular system of the lower extremity. Clinical manifestations include edema, induration, skin discoloration, aching pain, and ulceration (3). Although frequently present, superficial varicosities are seldom a prominent feature of chronic venous stasis syndrome (3). The deep venous system is almost always abnormal; that is, it demonstrates reflux at descending venography in symptomatic patients with chronic venous insufficiency (4).

There appear to be two main pathologic abnormalities that cause venous valve reflux: postphlebitic valvular incompetence and primary valvular incompetence. In veins that have been affected by phlebitis in the past, the valves have a thickened, scarred, and shortened appearance (1,3). Since the valve apparatus has been destroyed in these patients, it will allow reflux or be incompetent. Frequently, however, there is no history or evidence of previous thrombophlebitis in patients being evaluated for chronic venous insufficiency (3–5). These patients suffer from a primary valvular incompetence (3). The valve stations in these patients show no evidence of previous inflammation at surgery (5). The valve cusp in primary valvular incompetence is generally a membrane-thin structure with a clean, normal-appearing endothelium (4,5). However, these valve cusps are shallow, with elongated, redundant valve cusp edges that prevent effective closure of the valve mechanism and allow reflux to occur (3–6). In the authors' experience, this primary valvular incompetence is more commonly the cause of chronic venous insufficiency than is the postphlebitic, scarred valve (6).

Whereas incompetence of the valves in the superficial veins may be responsible for the development of simple varicose veins, chronic venous stasis syndrome occurs when there is valvular incompetence of the deep venous system associated with incompetence of the perforating venous valves in the calf (3). Incompetent valves in the deep venous system are responsible for reflux and retrograde deep venous flow. These produce distention of the deep veins within the calf, which may be responsible for the patient's discomfort (3). The increased pressure that the incompetent deep venous system places on the perforating veins produces dilatation and incompetence of their valves also (3). Increased capillary pressure in the subcutaneous tissues occurs, producing exudation of red blood cells and fluid. The breakdown products of these red blood cells in the tissue fluid exudate are responsible for hyperpigmentation and induration (3). It has been suggested that the increased capillary permeability results in fibrin deposits around the capillaries, preventing efficient diffusion of oxygen to adjacent tissue (7). Consequently, the ability to heal following minor trauma is reduced, thereby allowing ulcers to develop (7).

Our data appear to support previous reports that deep venous reflux, either alone or in combination with superficial venous reflux, is the primary basis for the clinical presentation of chronic venous insufficiency disease (4). Of the 485 legs we examined that did demonstrate reflux, reflux into the deep venous system occurred in 98%. Isolated reflux into the superficial venous system (saphenous vein) was extremely uncommon, occurring in only 2% of those extremities which showed reflux. In 82% of the legs that demonstrated reflux, all of the reflux occurred into the deep venous system alone. These data support the theory that the clinical syndrome of chronic venous insufficiency is produced primarily by reflux into the deep venous system, whether alone or in combination with superficial venous reflux. Isolated superficial venous insufficiency was rare in our group of symptomatic patients.

The high prevalence of bilateral reflux in our series of patients who underwent bilateral descending venography is also noteworthy. Postphlebitic changes tend to be unilateral (5). The high prevalence of bilateral reflux in our series supports the view that deep venous insufficiency is more often related to a primary abnormality in the development of the valves than to valve destruction from previous thrombophlebitis.

Drawing on our experience, we have now settled on the following standard technique for performing descending venography, a technique that is a modification of the one originally described by Herman et al (8). As in all of the cases in our series, the catheter tip is positioned at the junction of the common femoral vein and external iliac vein. The patient bears weight on a block placed under the contralateral foot so that the leg being examined will be relaxed and bear no weight. We now perform these studies by having the patient's head at 60° elevation only and using a standardized Valsalva maneuver only. Our rationale for arriving at this technique is discussed below.

Many reports in the literature support the performance of descending venography with the patient in the supine position rather than in the semierect position (9–12). The stated reason for performing these studies with the patient supine is that the higher specific gravity or density of the contrast material as compared to blood causes the contrast material to pass slowly downward while the patient is in the semierect position. This has been assumed to exaggerate or falsely increase the degree of reflux. It has been speculated that, in the semierect position, even normal venous valves may allow reflux of heavy contrast material (9). However, we have not found this to be a significant problem. It is true that a small amount of contrast material may settle through open valve cusps during quiet or normal breathing, but this has been accepted as normal (1). Most of the contrast material flows superiorly toward the heart during quiet breathing. However, when the Valsalva maneuver is performed and the valve stations are stressed, the valve cusps should close tightly and be competent, whether or not the contrast material is heavier than blood. In our series of descending venograms, the semierect position was used in three of four techniques. The percentage of legs that demonstrated no reflux whatsoever in the the semierect position ranged from a low of 16% to a high of 23%. However, the percentage of legs with no reflux when patients were in the supine position was 59%. This relatively high rate of negative examinations with the supine position did not correlate well with the results obtained with the semierect position and was believed to correlate poorly with the strip test (4) performed intraoperatively to demonstrate valvular incompetence, although no objective data were generated on this latter point. For these reasons, and because a more erect position would seem more physiologic than the supine position, we now prefer to perform all of our descending venograms with patients in the semierect position.

Once we had chosen to perform all our descending venograms with patients in the semierect position, we decided to perform all of the studies at 60° rather than 30° head elevation because of concern over the possibility of missing some cases of reflux at the lesser elevation. We had investigated the feasibility of performing descending venography at 30° elevation because not all radiographic examining tables will elevate to a full 60°. Although the examination results were consistent in 59% of the patients studied at both 30° and 60°, in a significant 41% of patients there was an increase in reflux at 60° compared to reflux at 30°, an increase sufficient to change the grading classification of the reflux. In none of our cases did more reflux occur at 30° than at 60° head elevation.

All of our descending venography is now performed with a standardized Valsalva maneuver. The patient is instructed to blow into the barrel of a 10-mL syringe attached to a mercury-column manometer and maintain the mercury column at the 40-mm mark while the contrast material is being injected. It would seem reasonable that an attempt at standardization of this procedure would yield more consistent results than simply requesting the patient to "bear down." We have abandoned the procedure of performing descending venography with normal respiration. Even though 54% of patients demonstrated a similar degree of reflux during both normal respiration and the Valsalva maneuver, 45% of patients refluxed substantially more with the Valsalva maneuver. In only 1% of the patients was there a significant increase in reflux seen with normal respiration compared with reflux during the Valsalva maneuver. This may have been due to normally functioning valves, which are open most of the time during normal respiration, but this part of the examination would not seem appropriate for determining the competence of a valve at closure. For this reason we have switched to performing our studies exclusively with the standardized Valsalva maneuver.

Our data confirm that deep venous reflux, either alone or in combination with superficial venous reflux, is the predominant cause of chronic venous stasis disease. Isolated superficial venous insufficiency is rare in this clinical condition. New surgical techniques can help the surgeon to repair and alleviate venous valvular insufficiency in these patients (4). The need for accurate diagnosis of valvular anatomy and valvular competence is therefore obvious. All patients with clinically significant chronic venous insufficiency disease should be studied with ascending and descending venography so that a proper course of treatment can be planned. ■

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