The Surgical Management of Vascular Diseases

edited by

Henry Haimovici, M

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Henry Haimovici, M.D.
Head of the Vascular Surgical Service,
Montefiore Hospital and Medical Center;
Clinical Professor of Surgery,
Albert Einstein College of Medicine,
New York, N.Y.

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Contributors

David S. Baldwin, M.D.
Associate Professor of Medicine,
New York University School of Medicine;
Chief, Hypertension and Nephritis Clinic,
Bellevue Hospital;
Associate Attending in Medicine,
University Hospital;
Consultant in Nephrology,
Veterans Administration Hospital,
New York, N.Y.

John J. Bergan, M.D.
Associate Professor of Surgery,
Northwestern University Medical School,
Chicago, Ill.

Seymour S. Bluestone, M.D.
Associate Attending, Montefiore Hospital and Medical Center;
Assistant Professor Rehabilitation Medicine,
Albert Einstein College of Medicine;
Director, Department of Rehabilitation Medicine, Morrisania Hospital,
Bronx, N.Y.

Allan D. Callow, M.D., Ph.D.
Professor of Surgery,
Tufts University School of Medicine;
Chief of Vascular Surgery,
Tufts New England Medical Center,
Boston, Mass.

Norman E. Chase, M.D.
Professor and Chairman,
Department of Radiology,
New York University Medical Center;
New York, N.Y.

Marvin L. Gliedman, M.D.
Professor of Surgery,
Albert Einstein College of Medicine;
Chief, Department of Surgery,
Montefiore Hospital and Medical Center,
Bronx, N.Y.

Robert H. Goetz, M.D.
Professor of Surgery,
Albert Einstein College of Medicine;
Chief of Vascular Surgery,
Albert Einstein College Hospital,
Bronx, N.Y.

Henry Haimovici, M.D.
Clinical Professor of Surgery,
Albert Einstein College of Medicine;
Head of Vascular Surgical Service,
Montefiore Hospital and Medical Center,
Bronx, N.Y.

Charles A. Hufnagel, M.D.
Professor and Chairman,
Department of Surgery,
Georgetown University School of Medicine,
Washington, D.C.

Michel N. Jurayj, M.D.
Associate in Surgery,
Northwestern University Medical School,
Chicago, Ill.

Harold Laufman, M.D., Ph.D.
Professor of Surgery,
Albert Einstein College of Medicine;
Attending Surgeon,
Montefiore Hospital and Medical Center,
Bronx, N.Y.

Robert R. Linton, M.D.
Emeritus Assistant Clinical Professor of Surgery,
Harvard Medical School;
Senior Attending and Consultant Surgeon,
Massachusetts General Hospital,
Boston, Mass.

Jere W. Lord, Jr., M.D.
Professor of Clinical Surgery,
New York University School of Medicine,
New York, N.Y.

Milton Margulies, M.D.
Assistant Professor of Radiology,
State University of New York
Downstate Medical Center
Brooklyn, N.Y.

Milton Mendlowitz, M.D.
Clinical Professor of Medicine,
Mt. Sinai Medical School;
Attending Physician,
Mt. Sinai Hospital,
New York, N.Y.

John Moossy, M.D.
Professor of Pathology and Associate in Neurology, The Bowman Gray School of Medicine, Wake Forest University, Winston-Salem, N.C.

Stanley S. Siegelman, M.D.
Associate Professor of Radiology, Albert Einstein College of Medicine; Associate Attending in Radiology, Montefiore Hospital and Medical Center, Bronx, N.Y.

Fiorindo A. Simeone, M.D.
Professor of Medical Science, Brown University; Surgeon-in-Chief, The Miriam Hospital, Providence, R.I.

Frank C. Spencer, M.D.
Professor and Chairman, Department of Surgery, New York University Medical Center, New York, N.Y.

Seymour Sprayregen, M.D.
Assistant Professor of Radiology, Albert Einstein College of Medicine; Adjunct Attending in Radiology, Montefiore Hospital and Medical Center, Bronx, N.Y.

Israel Steinberg, M.D.
Emeritus Professor of Radiology, Cornell University Medical College, New York, N.Y.

Jerome Tobis, M.D.
Professor of Rehabilitation Medicine, Albert Einstein College of Medicine; Chief, Department of Rehabilitation Medicine, Montefiore Hospital and Medical Center, Bronx, N.Y.

Otto H. Trippel, M.D.
Associate Professor of Surgery, Northwestern University Medical School, Chicago, Ill.

Irving S. Wright, M.D.
Emeritus Clinical Professor of Medicine, Cornell University Medical College, New York, N.Y.

Preface

In the past two decades, advances in the field of cardiovascular diseases stand out as among the most impressive achievements in medicine. Although as a result of this progress the outlook for patients suffering from cardiovascular diseases has greatly, sometimes even radically, improved, much still remains to be accomplished. The search for further solutions to these problems is being continued on a vast scale by investigators representing multiple scientific and medical disciplines.

Vascular diseases occupy a place of major significance among the ailments of modern man. The appalling toll exacted from our Western population by the atherosclerotic process, the most common cause of arterial diseases, has produced a heightened interest in these diseases from both medical and lay public. In the rates of disability and death, arteriosclerosis still supersedes any other disease.

Since the advent of the current vascular surgical era, great strides have been made in the understanding and management of arterial diseases. These achievements were made possible by significant contributions from several of the medical, radiologic, hematologic and surgical subspecialties.

The main rationale for the development of reconstructive arterial surgical principles is based upon the concept of segmental distribution of the vascular lesions. This fundamental notion was established first by pathological studies, then by arteriography and was abundantly corroborated by operative findings. Implementation of these surgical principles was brought about by the introduction of thromboendarterectomy and vascular grafting procedures around the year 1950.

As medical history not infrequently indicates, a great hiatus often elapses between the time of discoveries and their clinical applications. Such a hiatus occurs in the history of vascular surgery. Indeed, the scientific bases for reconstructive arterial surgical procedures were laid by Carrel and Guthrie at the turn of this century. However, it was not until about four decades later that this knowledge found its way from the research laboratory to its present-day successful surgical application. As a result, aneurysms, with their dreadful prognosis, the occlusive diseases of the somatic vessels, and those of the vital organs have been shifted from the collumn of fatal to curable diseases.

The last twenty years have thus witnessed a phenomenal growth of broadened applications of vascular surgery to a great variety of vascular disorders. Long-term follow-up studies of these patients should, and do, afford today a critical appraisal of the results obtained with the various methods for their management.

This volume includes the contributions presented at a recent SYMPOSIUM ON VASCULAR DISEASES, sponsored by Montefiore Hospital and Medical Center and Albert Einstein College of Medicine, Bronx, New York, held on May 26–28, 1969. This Symposium was designed to present a comprehensive review of the most recent advances concerning diagnostic methods and therapeutic procedures for some of the most important venous and arterial diseases amenable to surgical correction.

In this era of medical knowledge explosion, it is sometimes difficult for the busy surgeon to stay abreast of scientific and medical developments even in his own specialty. The contributors to this volume, mindful of their role in the continuing medical education program, have presented the various problems based on their personal experience, and have also critically evaluated the most pertinent recent literature. In this way the reader may easily sift the newer facts from the obsolete.

I wish to take this opportunity to express my deep appreciation to all the contributors for their gracious cooperation in making this publication possible, and for their efforts in presenting an up-to-date account of the various challenging facets of the circulatory disorders included in this volume.

HENRY HAIMOVICI, M.D.

One enlarges science in two ways: by adding new facts and by simplifying what already exists. . . .

In the history of science it is not enough to recount what everyone may have said, blemished by the errors of each period. It is necessary to characterize each idea, then to criticize it and even to reject things if they are bad, for historical science consists not only in accumulating, but in choosing the useful materials and making them bear fruit.

Claude Bernard (1813–1878)

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Venography, Angiocardiography, Radioisotope Scanning

Their Diagnostic Value in Venous Thrombosis and Pulmonary Embolism

Israel Steinberg, M.D.

The practical method of visualizing the four cardiac chambers and the great blood vessels in man was reported by Robb and Steinberg in 1938 and January, 1939.[1,2] Angiocardiography was achieved by the rapid intravenous injection of a concentrated organic iodine compound. Speed of injection was secured by designing a special 12-gauge bore syringe and needle stopcock unit which permitted the injection of 50 ml. of concentrated contrast agent in 1½ seconds. Speed of injection was also facilitated by elevation of the arm and instructing the patient to inhale and arrest breathing without performing the Valsalva maneuver. The intravenous method was modified in 1959 in order to increase the bolus effect and to visualize the abdominal aorta and peripheral vascular system more regularly. Bilateral, simultaneous, intravenous injections enhanced angiocardiography,[3] achieved abdominal aortography and peripheral arteriography[4,5,6] and made it possible to inject larger quantities of contrast material (up to 100 ml.) for the cardiovascular visualization of heavily built and obese people and patients with cardiomegaly owing to heart failure, valvular heart disease, or aortic aneurysms. In 1964, the technique of intravenous angiocardiography was again changed to permit visualization of the cardiovascular structures with a single arm injection.[7]

METHOD

Percutaneous insertion of the Robb-Steinberg needle stopcock unit is made with the patient in the supine position. In the absence of a large arm vein, it is desirable to perform a cutdown for placement of the cannula. After the needle stopcock unit is inserted into the vein, it is fixed in position with adhesive tape. The intravenous location of the needle is assured by flushing with normal physiologic saline solution.[8] With arm elevated, the modified circulation time with sodium dihydrocholate (Decholin) is determined. This is especially important when the abdominal aorta is to be visualized, and when there is heart disease (valvular and congestive heart failure). It is essential to explain the object of the circulation time and rehearse the procedure with the patient so that he will recognize the bitter taste of Decholin and avoid the Valsalva maneuver. It is for this reason and in order to have the patient alert and cooperative that premedication with sedatives is not advised.

The details of the circulation time determination have been previously published.[4,5] However, it bears repetition because improper technique of circulation timing is the commonest reason for failure to visualize the abdominal aorta. Three milliliters of a 20 per cent solution

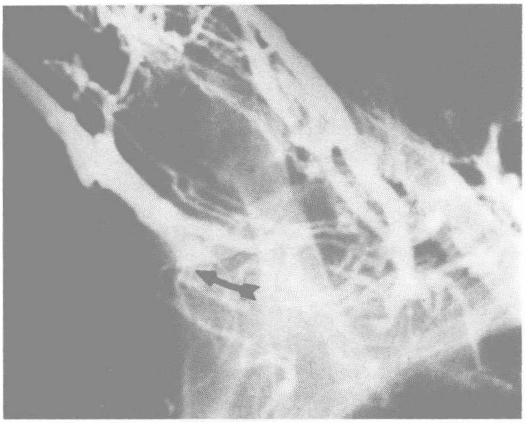

FIG. 1–1. Arrow indicates site of primary thrombosis of the axillary vein (Paget-von Schrötter syndrome). (Steinberg, I.: Amer. J. Roentgen., 98:388, 1966)

of Decholin are mixed with 15 ml. of physiologic saline solution in a 20-ml. syringe and attached to the Robb-Steinberg cannula. The arm is elevated making certain that is is relaxed at the shoulder (this avoids physiologic obstruction of the subclavian vein underneath the first rib). The stopcock is opened and the patient is instructed to breathe out gently. Then he is asked to breathe in making certain that only a moderate breath is taken, for it is important to avoid the Valsalva maneuver, which tends to delay circulation into the heart. Injection of the Decholin-saline mixture is made simultaneously with the direction to breathe in. This is also the signal for the technician to start the stopwatch. Once the injection is completed, the patient, having been told to anticipate a bitter taste, is urged to go through the motion of tasting by smacking his lips, tongue and mouth; this automatically releases the tendency to perform the Valsalva maneuver. The onset of the bitter taste is recorded by stopwatch. The modified circulation time from arm to tongue is a valuable guide for the duration of the roentgen exposure for cardiovascular angiography and for abdominal aortography and peripheral arteriography. If the accuracy of this determination is uncertain, it is essential to repeat the procedure.

The position of the patient for single arm pressure injection is supine on a horizontally placed rapid, multiple, serial 14- by 14-inch Schönander magazine. The outstretched extended arm containing a Robb-Steinberg needle taped with adhesive is connected to the Gidlund pressure injector by a special (Piling 13-gauge) polyethylene adapter connector. Additional adhesive taping to fix the adapter connecting tubing can be used to stabilize and prevent dislocation of the Robb-Steinberg cannula.

Injection of the concentrated contrast medium is made in 1½ to 2 seconds at a pressure of 5 to 6 kg./cm². The dose of contrast material is 1 ml. per kilogram of body weight. Before injection of contrast material, a small quantity, usually 1 to 2 ml., is manually injected by turning the wheel of the Gidlung injector. This is done to make certain that the cannula is well within the vein. In the absence of arm pain, tissue infiltration is ruled out and the angiographic studies are begun. For angiocardiography, filming begins at the precise moment of injection and continues for the duration of the circulation time. The patient is also forewarned and reassured about an intense wave of heat and throbbing in the head of short duration. Programming, depending on the number of films per second desired with delays at appropriate intervals, may be estimated with great accuracy once the circulation time has been determined. For instance, in rheumatic heart disease every other slot of the Schönander magazine is loaded for 15 films, and this provides a study of either 5 or 22 seconds duration depending on whether roentgen exposures are made at 1-second or 1.5-second intervals. Should the circulation time be longer than 22 seconds, predetermined delays during the pulmonary circulation (arteriovenous) phases may be secured by programming with the Schönander electronic timer device.

Abdominal aortograms and peripheral arteriograms are obtained by utilizing an automatic movable table (the Koordinate) over a Schönander magazine. Here, too, the circulation time is of paramount importance. Usually, filming is begun 1

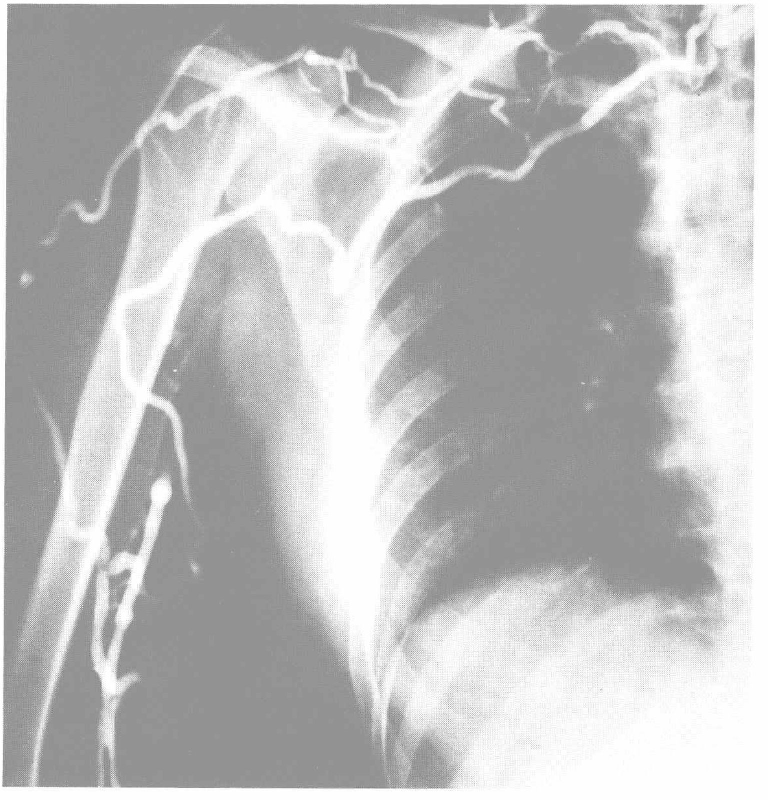

FIG. 1–2. Chronic right axillary vein thrombosis (Paget-von Schrötter syndrome) of 1 year's duration. Note few collaterals. (Steinberg, I.: Amer. J. Roentgen., 98:388, 1966)

second before the Decholin circulation time. Five roentgenograms at intervals of 0.75 second are made. To prevent blurring during movement of the table, the sixth slot in the Schönander magazine is not loaded. Exposures of the pelvis (in the second table stop) are then made at intervals of 0.75 second for 3 films. Similarly, 3 exposures of the thighs and legs are made, respectively, following a blank shot at the end of 3 sets of films.

Since the patient is supine and stationary during angiocardiography, the Piling polyethylene connecting adapter tubing between the Gidlund syringe and needle stopcock unit need not be disconnected. Because of automatic movements of the table during peripheral arteriography,[9] it is necessary to disconnect one end of the connecting Piling tubing from either the patient or the Gidlund injector. After practice, this can be readily achieved before roentgenography of the abdominal aorta begins. At the completion of the studies and while the films are being processed, the solid hub bore is inserted into the lumen of the Robb-Steinberg needle to prevent clotting in the cannula. In aortotomography,[6] however, detachment of the Gidlund injection device from the Piling connecting tubing is not necessary until completion of the studies since the patient remains in a stationary position during the multiple filming. Removal of the needle is followed by tight bandaging of the needle puncture site with sterile gauze. Usually, the snug dressing can be removed after 2 hours, and a light sterile Band-Aid applied.

Discussion of Method

To decrease the risk of arm infiltration, it is important to make certain that the cannula is well placed in the vein. This can easily and quickly be tested by injecting physiologic saline solution through the cannula and watching for extravasation. Reinsertion of the Robb-Steinberg needle into another vein either

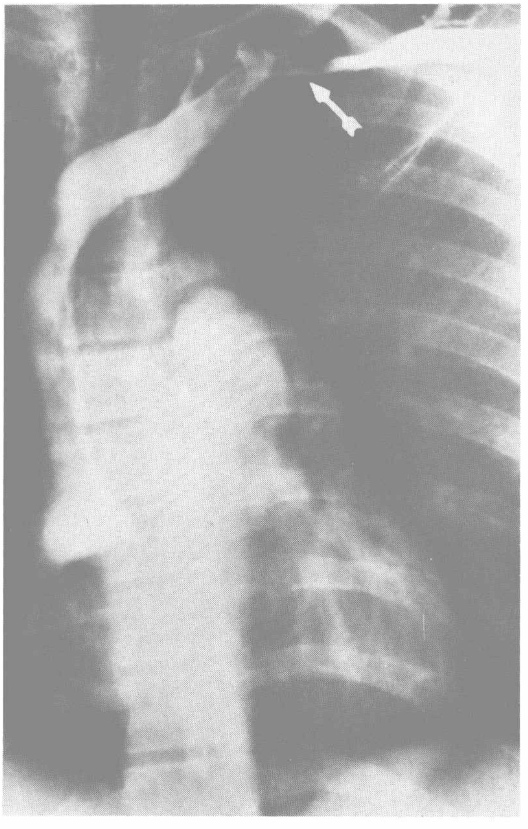

FIG. 1–3. Point of physiologic stenosis of left subclavian vein (arrow), a common occurrence in intravenous injection of contrast material.

percutaneously or by cutdown is recommended whenever there is local edema of the arm following physiologic saline injection. Finally, as a further precaution, just before injection of the contrast medium a small test dose of 1 to 2 ml. of the contrast agent should be injected with the Gidlund apparatus as described above. As an added safety measure in order to prevent dislodgment of the needle during injection, the Piling connecting tubing is immobilized by adhesive tape for angiocardiography or may be held for the duration of the injection (2 seconds) during abdominal aortography and peripheral arteriography. At the completion of the injection, the tubing can be disconnected from the Gidlund apparatus so that movement of the automatic table will be unhindered.

In any event, it is recommended that both the needle and Piling connector tubing be well immobilized during the injection.

Local infiltration of the arm tissues with concentrated contrast agents, even in small quantities, is extremely painful. Immediate treatment by injection of large quantities of physiologic saline solution into the dislodged cannula will considerably dilute the concentration of the contrast agent, especially if the cannula is no longer in the vein, and will reduce pain and tissue damage. Hyaluronidase solution, because it hastens absorption of contrast media, is also injected into the tissues via the dislodged cannula. If pain persists, injection of procaine solution, 1 per cent, locally into the painful areas is advised, and this medication should be continued until pain is alleviated. Sedation with barbiturates or narcotics may also be necessary. Hot packs applied to the site of infiltration will also give comfort.

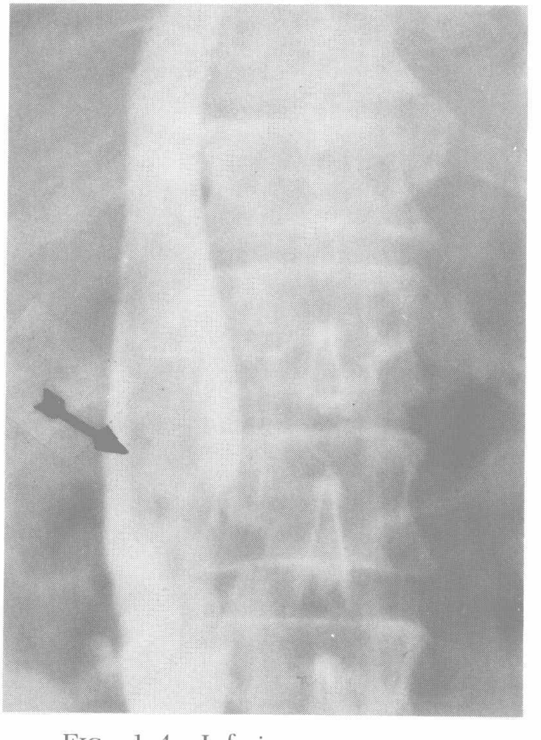

FIG. 1–4. Inferior vena cavogram showing thrombus (arrow).

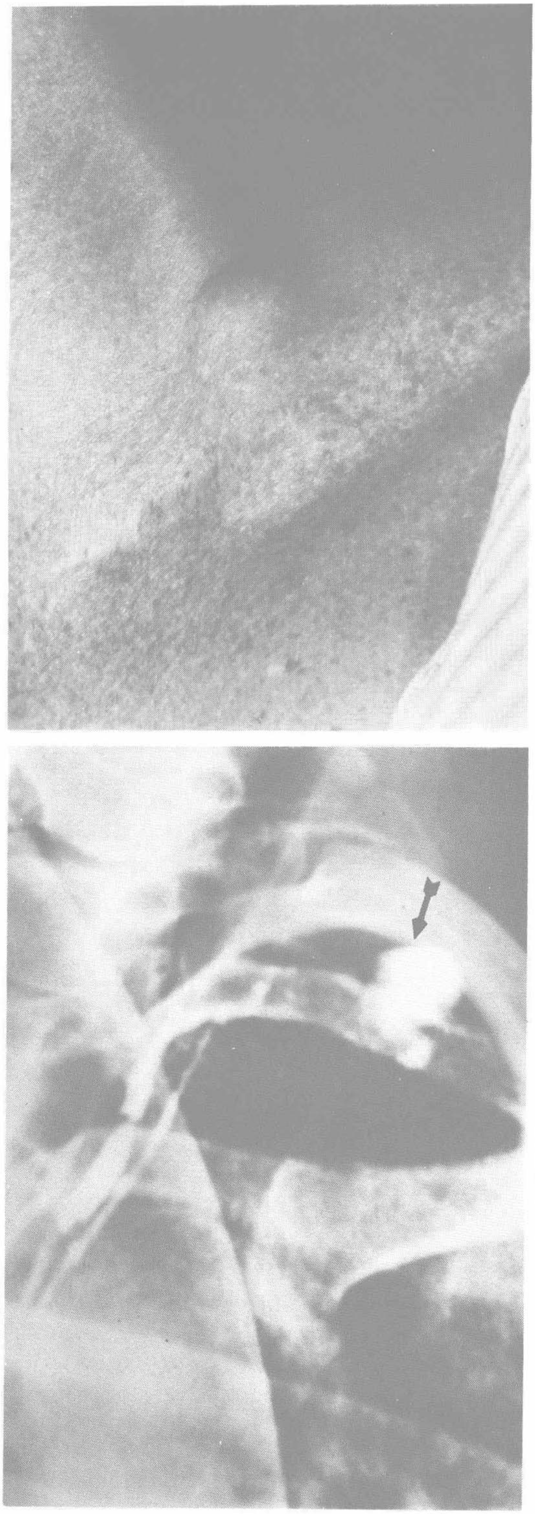

FIG. 1–5. Persistent jugular lymph sac. (*Top left*) Mass left supraclavicular area during Valsalva maneuver. (*Top right*) Notice opacification of saccular structure (arrow) during venography done during Valsalva maneuver. (*Bottom left*) Lymphangiogram outlining jugular sac (arrow). (*Bottom right*) Lymphangiogram showing thoracic duct (arrow). (Steinberg, I., and Watson, R. C.: New Eng. J. Med., 275:1471, 1966)

Localized slough of the skin has been rare following the procedures outlined above.

Insertion of catheters into the arm and superior vena cava has also been used for intravenous angiography and abdominal aortography and is very satisfactory. Usually, this requires a cutdown, although the percutaneous technique for insertion of large catheters is available. In any event, large-bore catheters of at least 12 gauge are essential. Although catheters rather than large-bore cannulas are recommended by some because they prevent stagnation of contrast material in the arms, trapping of contrast material in the arm or neck veins can be avoided if the arm used for injection is elevated and the patient is taught to avoid the Valsalva maneuver. Indeed, when the Valsalva maneuver was inadvertently performed during an angiocardiographic study made recently at another hospital, marked regurgitation of contrast material into the jugular veins occurred even though the catheter had been inserted into the right atrium.

Pressures of 5 to 6 kg./cm.[2] with the Gidlund apparatus have uniformly resulted in flow rates of 1½ to 2 seconds when Angio-Conray (iothalamic acid, 80 per cent) was used. Flow rates of the more viscid concentrated organic iodide contrast agents have been slower than with Angio-Conray; therefore, the use of Angio-Conray assures a speed of injection of 1½ to 2 seconds, a rate which has long been found satisfactory for intravenous angiocardiography during the past 30 years. Other, less expensive pressure devices, whether they release pressure automatically or after manual manipulation, are suitable providing they permit a flow rate of 1½ to 2 seconds.

Failure to visualize the abdominal aorta, irrespective of whether double or single arm injections are made, is most often caused by imperfect circulation time determination. Since the determination of the Decholin circulation time is of great importance, care is necessary that a large-bore 12 gauge cannula such as the Robb-Steinberg needle is inserted into the arm. The arm must be elevated and the patient placed in the position that he will assume for contrast cardiovascular visualization studies. The patient must also be alerted to anticipate the bitter taste and instructed how to avoid the Valsalva maneuver. Indeed, it is because the patient's cooperation is essential for the securing of the correct circulation time and later the contrast studies that premedication of any type is avoided. Furthermore, an accurate stopwatch, and not the ordinary wristwatch, must be used for recording the moment of bitter taste. Finally, roentgen apparatus, especially serial automatic electronic devices, often have varying lags before roentgen exposure and initiation of the movement of the serial film devices. These lags must be ascertained and allowances made for them. Only then will the circulation time be meaningful.

This technique has resulted in superb angiocardiograms, abdominal aortograms, and peripheral arteriograms even in muscular and overweight patients. Huge thoracic aortic and abdominal aortic aneurysms and enlarged and dilated hearts of patients in heart failure have been regularly visualized.

Improper determination of the circulation time with Decholin is the commonest reason for failure to visualize the abdominal aorta and peripheral vascular circulation with the intravenous method. For successful performance of the circulation time—and contrast visualization of the abdominal aorta and peripheral vascular circulation—the following are essential: A large-bore (12-gauge) Robb-Steinberg cannula or catheter must be well inserted into the largest vein of the arm. The patient must be taught to anticipate the bitter taste of Decholin. He must be instructed how to breathe and how to avoid the Valsalva maneuver. A stopwatch must be used for timing. Lags inherent in roentgen apparatus, whether of exposure time or of serial roentgen electronic devices, must be ascertained, and allowance for these made. Finally, reassuring an alert nonsedated patient concerning the intense wave of heat will regularly result in successful angiographic studies.

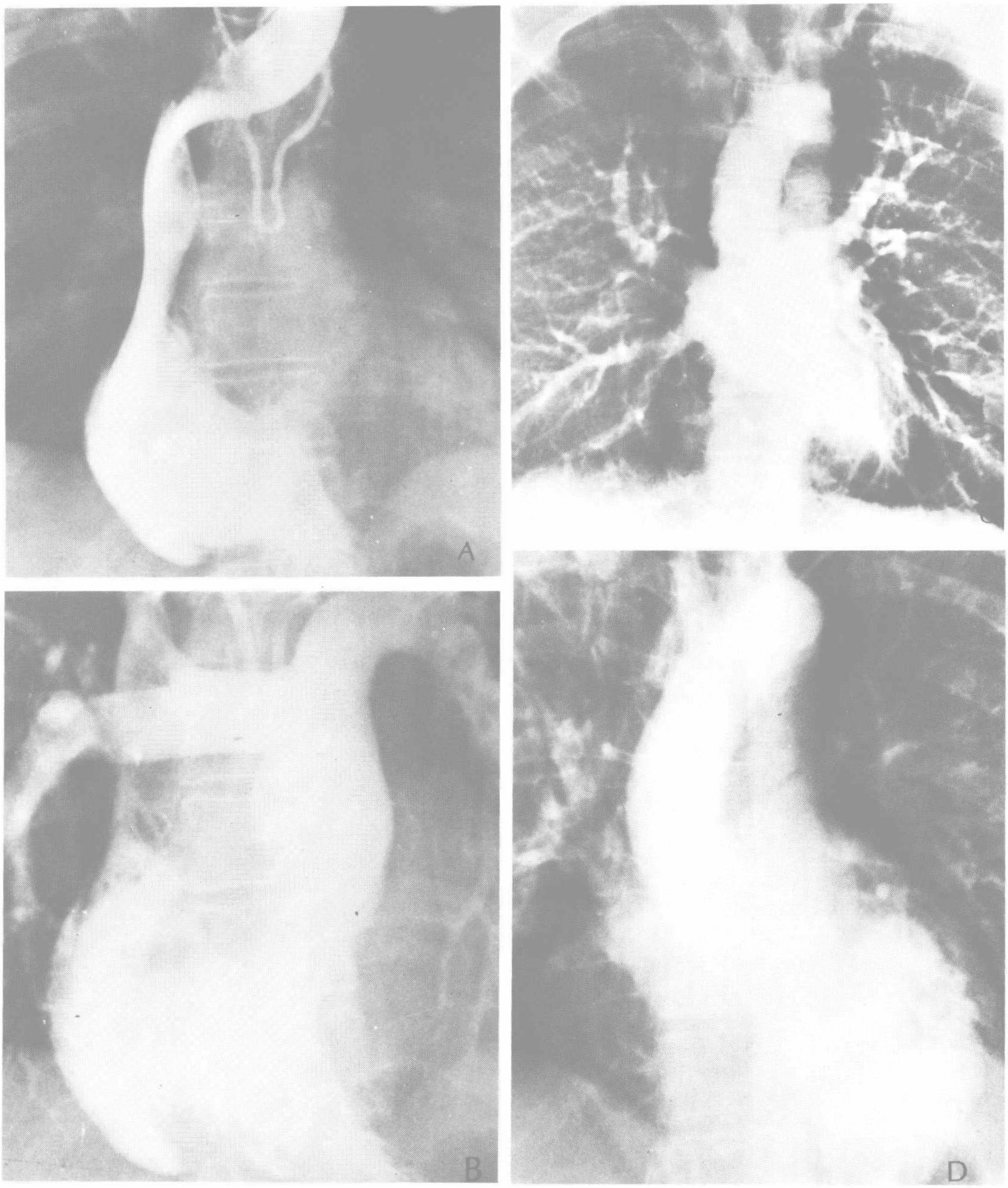

FIG. 1–6. The normal cardiovascular system. (A) Serial intravenous angiocardiography showing the left subclavian and innominate veins, the superior vena cava, and the right atrium. (B) The superior vena cava is empty but the right atrium (in systole), the ventricle, pulmonary artery, and branches are opacified. (C) The opacified superior and inferior pulmonary veins are filling the left atrium. (D) When the left ventricle fills, there is opacification of the aorta. Note normal thickness of the left ventricle.