Historical landmarks of angiography, i.e. angiocardiography, abdominal and thoracic aortography as well as arteriography and venography are described.

1. Beginnings of Angiography (1896-1929)

1.1. Historical Landmarks

1896 Haschek and Lindenthal (32) opacified vessels of an amputated hand using Teichmann's mixture.
Braus (11) demonstrated veins and arteries of a hand using mercury.
1907 Kassabian (40) demonstrated vessel utilizing bismuth subnitrate and mercury.
1910 Franck and Alwens (29) injected a suspension of bismuth and oil into the heart of dogs and rabbits and observed the passage of the contrast medium from the heart to the lungs.
1912 Bleichröder (10) performed intravascular catheterization for intra-arterial chemotherapy.
1913 Hauck (33) demonstrated normal and pathological renal arteries post mortem.
1920 Orrin (51) opacified arteries of different organs on corpses.
1923 Berberich and Hirsch (7) performed the first arteriography with strontium bromide in man.
1924 Brooks (12) demonstrated the arteries of lower extremities in living man following intraarterial injection of sodium iodide.
1925 Coapody (19) opacified arteries with Lipiodol.
1927 Harvier and Lemaire (31) performed arteriography using Lipiodol as contrast agent.
Moniz (45) performed the first cerebral arteriography using sodium iodide.
1928 Singleton (66) performed peripheral arteriography using sodium iodide.
1929 Charbonnel and Masse (18) performed peripheral arteriography and described angiographic signs of arteritis.

1.2. Pioneers, Biographical Notes

Joseph Berberich was born in 1897. He received his medical degree from the University Medical School, Frankfurt am Main, and he was trained in the Ear-Nose-Throat-Clinic in Frankfurt. In 1932 he was appointed Director of the
Otorhinolaryngological Department of the City Hospital in Berlin-Neukölln. In 1938 he left Germany for England. In 1940 he went to the United States where he worked at the Mt. Sinai Hospital, New York. Berberich is the founder of the journal « Practica Otorhinolaryngologica ».

Samson-Raphael Hirsch was born in 1890 in Hannover. He received his medical degree from the University of Heidelberg in 1914. He was a senior physician at the Municipal Hospital in Frankfurt am Main. In 1938 Hirsch emigrated to Brussels. He published more than one hundred scientific papers. Hirsch died in Rome on October 2, 1960.

Egas Moniz was born in 1874 in Avanea, Portugal, and was named Antonio Caetano de Abreu Freire. As a student at the University of Coimbra he adopted the pen name of Egas Moniz. He graduated from the University in 1899, and then studied neurology in Bordeaux and Paris. Moniz was fifty-two years old when he conceived the idea of visualizing the cerebral vessels by X-rays. Eight years later, he described prefrontal leucotomy for the treatment of mental diseases. For these two endeavors Moniz was awarded the Nobel Prize in Medicine in 1949. Moniz died in 1955.


2. Beginnings of Angiocardiography (1929-1951)

2.1. Historical Landmarks

1929 Forssmann (27) catheterized the right heart.
1931 Forssmann (28) demonstrated the chambers of the right heart and the lung arteries in dog.
Moniz, de Carvalho and Lima (46) performed pulmonary arteriography.
1933 Reboul and Racine (59) reported the experimental angiocardiography.
Rousthol (61) performed experimental angiocardiography and coronarography with Thorotrast introducing catheter via carotid artery.
1936 Nuvoli (49) used direct punction of the thoracic aorta in order to demonstrate an aneurysm.
Ameuille (2) reported the clinical application of angiocardiography and pulmonary arteriography.
Janker (36) applied cine-technique in angiocardiography.
1937 Castellanos, Fereiras and Garcia (13) accomplished the opacification of the heart and pulmonary vessels in children with congenital heart disease by intravenous injection of contrast medium.
1938 Robb and Steinberg (60) reported clinical experience with angiocardiography.
1945 Grossman (30) demonstrated coronary arteries in dog using injection of Diodrast into the ascending aorta.
1946 Celis (16) published the first paper on angiocardiography.
1947 Chavez, Dorbecker and Celis (17) performed direct intracardiac angio-
cardiography introducing a heart catheter through the external jugular vein.

1948 Hoyos and Del Campo (34) opacified coronary arteries in man injecting Diodrast following direct puncture of the ascending aorta. Jönsson (37) reported direct coronaryography in man performing the aortography with a catheter.

1949 Jönsson (38) performed the selective angiography.

1951 Ponsdomenech and Beato Nuñez (53) performed angiography using direct heart puncture.

2.2. Pioneers, Biographical Notes

Werner Forssmann was born in 1904 and educated at the University of Berlin. Working at the hospital in Eberswalde near Berlin, he undertook a series of experiments (catheterizing himself!) which led to catheterization and contrast demonstration of the cavities of the right heart in 1929, and of pulmonary arteries in 1931. His scientific work was not appreciated by his colleagues, but Courand and Richards from the United States utilized Forssmann’s initial studies as the basis for developing clinical cardiac catheterization. In 1956 Forssmann was named to share the Nobel Prize with Courand and Richards.

Henri G. Reboul was born in 1905 in Limoges, France. He took internship at the College of France practising vascular grafting and suturing. Later on, he performed experimental cardiac ventriculography and carried out serial arterio-phlebography in man. Reboul created a serigraph and an injector for contrast agent in 1945.

Maurice Racine was cardiologist at St. Maurice Hospital (Seine). He was engaged in problems of circulation, and in 1934 he published his thesis on the « Roentgenologic Aspects of the Circulation ». He studied the disturbances of the cerebral circulation in mental diseases and psychoses. Racine also studied the modification of the vascular bed in pulmonary collapse therapy.

Peter Rousthüi was born on July 15, 1903 in Aalborg, Denmark. He completed his medical studies in Stockholm in 1931 and worked at the Serafimer-lasarettet. In 1933 he conceived and performed the studies on angiography. In subsequent years he moved into other areas, and he was engaged in the private practice of internal medicine in Stockholm. He died on January 20, 1957, of retroperitoneal sarcoma.

Innocenzo Nuvoli was born in Rome in 1900. He received his medical degree from the University of Rome in 1924. In addition to his work in the field of angiography he made important contributions in diagnostic and operative esophagoscopy. Innocenzo Nuvoli died on February 5, 1937.

Robert Janker was born in 1894 in Munich. He received his medical degree in 1921. From 1928 to 1937 he was director of the Roentgen Institute of the University Surgical Clinic in Bonn. In 1937 he established his own Roentgen Institute in Bonn which is now Robert Janker Clinic and Robert Janker Center. Principal field of Robert Janker’s activities include the development of indirect roentgen-cinematography, the development of fluoroscopic photography, the application of electronic image intensification to roentgen-cinematography, and the utilization of television for roentgendagnosis. Robert Janker published nine books and more than 200 scientific papers. R. Janker died in 1964 in Bonn.

Augustin Castellanos y Gonzales was born in Cuba in 1902. He was educated in Havana where he received his degree in 1925. In 1935 he founded the Municipal Children’s Hospital in Havana. He left Cuba in 1961 and then
worked at the Children's Hospital in Miami. Castellanos and Pereiras published results of their work in 1937, but the studies which led to the development of angiocardiography in human beings were started in 1931. Angiocardiography was based on careful cadaver studies.

Raul Pereiras Valdes was born in 1904 in Havana, Cuba. He received his degree of Doctor of Pharmacy in 1928 and the degree of Medical Surgeon in 1934. He was in charge of radiology first at the Calixto Garcia University Hospital and later on at the Municipal Children's Hospital in Havana. He was engaged in cardiovascular contrast radiology.

George Porter Robb was born in 1898 in Syracuse, New York. He attended Indiana University and graduated at the Indiana University School of Medicine in 1926. While working as an instructor in clinical medicine at the New York University College of Medicine, he divised, together with Israel Steinberg, the method of angiocardiography, applicable not only to children but also to adults.

Israel Steinberg was born in 1902. He was educated at Harvard College and graduated at the Harvard Medical School in 1928. After internship at Boston City Hospital he became a resident at Bellevue Hospital. Together with George P. Robb, he developed the method of angiocardiography utilizing circulation times as an index to obtain exposures during both right and left heart opacification. He is the author of a large number of papers on angiocardiography.

Alejandro Celis was born in 1908 in Mexico. He attended the National School of Medicine in Mexico and completed his education in 1933. He was chief of the pulmonary disease section of the General Hospital of Mexico City and professor at the National University Medical School. Alejandro Celis is the author of many papers on pulmonary and cardiac disease.

Elmo R. Ponsdomenech was born in 1919 in Matanzas, Cuba. He studied medicine at the University of Havana School of Medicine and received his doctor's degree in 1943. He made postgraduate studies at the Massachusetts General Hospital in Boston and at the Memorial Hospital in New York. In 1951, Ponsdomenech described, together with Virgilio Beato-Nuñez, the technique of heart puncture in order to demonstrate the ventricular chambers and great arteries.

3. Beginnings or Arteriography (1929-1952)

1929 Dos Santos, Lamas and Caldas (22) reported the method of translumbar aortography and demonstration of visceral arteries.

1933 Moniz, Pinto and Alves (47) developed an open indirect method of vertebro-basilar arteriography injecting the contrast into the exposed subclavian artery.

1936 Loman and Myerson (44) described the first percutaneous puncture of the common carotid artery for the visualization of cerebral vessels.

1937 Shimidzu (64) used percutaneous injection of contrast medium into the supraclavicular portion of the subclavian artery for vertebrobasilar arteriography.

1938 Ichikawa (35) described opacification of renal arteries.

1939 Castellanos and Pereiras (14) reported retrograde thoracic aortography injecting contrast agent via brachial artery.

1941 Farinas (26) described retrograde aortography introducing catheter via femoral artery following surgical exposure.
1945 Radner (54) achieved the first coronary arteriography in man.
1947 Radner (55) performed intracranial arteriography via vertebral artery.
1948 Radner (56) introduced catheter via exposed radial artery and performed thoracic aortography.
1951 Bierman (8) performed selective catheterization of visceral arteries.
Peirce (52) used puncture of femoral artery for the percutaneous introduction of the catheter.
1952 Seldinger (62) used a special puncture needle for percutaneous introduction of guide wire and catheter.

3.2. Pioneers, Biographical Notes

Reynaldo dos Santos was born in Vila Franca de Xira, Portugal, in 1880. He completed his studies of medicine in Lisbon. For the training in surgery he went to Paris and to the United States. Returning to Lisbon in 1906 dos Santos was appointed surgeon in the Hospitais Civis. His studies on arteriography of the extremities and on aortography achieved particular renown.

Augusto Lamas was surgeon at the Hospitais Civis in Lisbon, and an assistant at the Lisbon Faculty of Medicine. Augusto Lamas collaborated from the beginnings with Reynaldo dos Santos and José Pereira Caldas in the field of arteriography and aortography.

José Pereira Caldas was born in 1893. He collaborated with Reynaldo dos Santos in the development of aortography and arteriography. As a radiologist he worked together with Egas Moniz as the latter developed cerebral arteriography. He also collaborated with Moniz in performing the first serial radiography of both the arterial and the venous circulation. For that purpose he constructed the apparatus which became known as the « Radio carrousel ».

Pedro Leandro Farinas y Mayo was born in 1892 in Santa Clara, Cuba. He graduated in medicine at the University of Havana in 1917. He became Director of the Department of Radiology in the Clinica de Dependientes of Havana. Farinas published numerous papers on ventriculography, urography, pneumoperitoneum, and bronchography. His special interest was devoted to the technique of the arteriographic examination of the abdominal aorta and its branches. Pedro Leandro Farinas, one of the most prominent radiologists of Latin America, died in 1951.

Stig Radner was born in 1913 in Sweden. He graduated at the University of Lund in 1939. Following training in internal medicine, neurosurgery and roentgenology, he was from 1951 to 1952 fellow of the Rockefeller Foundation in the cardiopulmonary laboratory at Bellevue Hospital under Dr. André Cournand. Radner described in 1945 the demonstration of the coronary vessels by direct aortic puncture and injection of contrast agent. In 1948 he published a paper on thoracic aortography by catheterization of the radial artery. Subsequently, in 1951, he presented a thesis on vertebral angiography by radial artery catheterization.

4. Beginnings of Venography (1923-1952)

4.1. Historical Landmarks

1923 Sicard and Forestier (65) performed fluoroscopic experiments in dogs after injection of iodized oil intravenously.
Berberich and Hirsch (7) published the first illustrated paper on veno-
graphy in a living human using a strontium bromide solution as contrast agent.

1930 Ratschow (58) used direct injection of Uroselektan for demonstration of varices.

1931 Sgalitzer, Kollert and Demel (63) performed leg venography using Abrodil and stereoscopic technique.

1934 Josefson (39) performed the first intraosseous injection of Lipiodol in corpses.

1935 Dos Santos (23) achieved the first successful phlebogram of the lower extremity and pelvis following surgical cannulation of the saphenous vein.

1937 Benda, Debray and Bourée (5) made the first experimental intraosseous injection of contrast media in guinea pigs.

1938 Dos Santos (24) introduced practical method of phlebography of the lower limbs.

1940 Benda, Orinstein and Depitre (6) described the first intraosseous injection of Lipiodol into the sternum of two living humans.

1941 Lindblom (43) performed ascending phlebography of the lower extremities.

1942 Bauer (4) described the phlebographic signs of thrombosis.

1943 Drasnar (25) demonstrated clinical value of the visualization of veins by intraosseous injection of a contrast agent.

1946 Castellanos and Pereiras (15) visualized the inferior vena cava after open cannulation of the saphenous vein at the ankle.

1947 O'Loughlin (50) described the method of pelvic and inferior caval phlebography by direct percutaneous puncture of the femoral vein in the groin.

1949 De Sousa Pereira (20) described the technique of portal venography at laparotomy.

1950 De Sousa Pereira (21) reported the first transparietal (percutaneous) splenoportogram in man.

1950 Moore and Bridenbaugh (48) published experiences with portal venography.

1951 Abeatici and Campi (1) published the paper on the percutaneous splenic portogram in dogs.

1951 Rappaport (57) visualized the hepatic venous system in animals by catheterization via vena cava.

1952 Bierman (9) introduced percutaneous transhepatic portal phlebography.

4.2. Pioneers, Biographical Notes

Jean Athanase Sicard was born in 1872. He introduced Lipiodol (iodinated poppy-seed oil) as a contrast material. He and J. Forester published a pioneering paper demonstrating the use of Lipiodol for bronchography, myelography, opacification of fistulas. Their communication constitutes the basis of radiologic contrast procedures.

Jasques Forestier was born in 1890. He is the pioneer in bronchography, myelography and vessel opacification. In collaboration with J.A. Sicard Forestier studied Lipiodol as contrast agent and wrote a doctoral thesis on this subject.

Raymond Benda was born in 1896 in Paris. He was professor at the College of Medicine for the Paris hospitals. In addition to his research on bone marrow, e.g. intramedullary injections of opaque media, he was chiefly inte-
rested in the study of tuberculosis. In collaboration with Debray, Bourée, Orin­
stein and Depitre he inaugurated intraosseous venography.

Elie Orinstein was born in 1911 in Paris. He received his medical degree and 
also asolved his internship in Paris. Orinstein was primarily interested in the 
study of diseases of the blood. Since 1945 he specialized in pulmonary pathology. 
In collaboration with Benda and Depitre he was engaged in the development of 
intraosseous venography.

Vladimir Drasnar was born in 1911 in Czechoslovakia. He received his medical 
degree from the Karls University of Prague. Since 1942 he worked in the 
surgical department of the hospital in Ostraka. In 1956 he was appointed head 
of the department of surgery in Liberec. Drasnar studied the methods of 
intraosseous injections and published nine papers on this subject.

Oscar V. Batson was born in 1894 in Sedalia, Missouri. He received his medical 
doctor degree at St. Louis University in 1920. From 1921 to 1928 he taught 
atomy at the University of Cincinnati. He became professor of anatomy at 
the University of Pennsylvania. Detailed studies of veins of the vertebral 
column were begun at the University of Cincinnati. The concept of a distinct 
vertebral vein system was published in 1940.

Antonio de Sousa Pereira was born in 1904 in Penafiel, Portugal. He received 
his medical degree at Oporto University in 1927. His postgraduate studies in 
surgery led him to the Clinique chirurgicale in Strassburg, to the John Hopkins 
Hospital, the Mayo Clinic, the Lahey Clinic, and to the Massachusetts General 
Hospital. Together with M.M. Adriao and J.L. Rodrigues he developed the portal 
venography.

George L. Moore was born in 1920 in Minneapolis, Minnesota. He received his 
Medicinae Doctor degree from the University of Minnesota in 1947. There he 
carried out a research program on the portal venography. In 1952 he became 
chief of surgery at the Roswell Park Memorial Institute in Buffalo.

Richard B. Bridenbaugh was born in 1920 in Billings, Montana. He received his 
Medicinae Doctor degree from the University of Colorado in 1944. Together 
with G.E. Moore he was engaged in the development of the portal venography.

Charles Louis Debray was born in 1907. He specialized in gastroenterology and 
baïneology. He became a clinical professor at the University of Paris Medical 
Faculty in 1955. He published a series of papers on the effects of pharmacologic 
substances on the roentgenologic examination of the intestinal and biliary 
system.

Sergio Abeatici was born in 1922 in Trieste, Italy. In 1949 he graduated at the 
University of Torino, and he became a specialist in general surgery and pro­
fessor in surgical pathology. Together with Luigi Campi he developed the method 
of splenoportography. In 1959 he was granted with Premio Marzotto.

Luigi Campi was born in 1922 in Imperia Oneglia, Italy. He graduated at the 
University of Torino in 1946, and became a specialist in radiology and professor 
in medical radiology. Luigi Campi was granted with Premio Marzotto for his 
research in splenoportography.

Lucien Leger was born in 1912 in Bastia, Corse. He absolved the internship and 
then became a surgeon at the Hôpitaux de Paris. He became chief of service 
at the Hôpital de Créteil, and professor at the Faculty of Medicine in Paris. 
Leger has greatly contributed in the development of the splenoportography.