ANGIOCARDIOGRAPHY is the study of the heart and blood vessels by means of roentgenography. The value of this special procedure in diagnosis of heart disease no longer can be doubted. In view of the risks still associated with the examination, angiocardiography could never be regarded as a routine procedure and used indiscriminately. The indication for this highly technical procedure is the anatomic location of the affected parts of the heart or blood vessels.

The technical aspect of angiocardiography should be planned with the idea of giving the surgeon an exact and complete answer to all questions of consequence for the operability and appropriate surgical technique. To reach this goal it is expedient for the x-ray technologist to obtain films of optimum diagnostic quality as required by the chief radiologist. To obtain such films under complex and hazardous conditions requires the teamwork of trained personnel.

Only one of the many technical methods of angiocardiographic examination will be considered in this paper. This is similar to the type used in the department of radiology of The Johns Hopkins Hospital. Since it is the duty of the x-ray technologist to have a well balanced knowledge of all aspects of any procedure in which he plays an important role, and since this is especially true in angiocardiography, a practical application of the anatomy of the heart and blood vessels is as mandatory as having detailed knowledge of the machinery and equipment used in this procedure.

The heart is divided into four chambers in which the blood supply of the body circulates. Each half consists of two chambers. The left side, from the anatomical anteroposterior position, includes the left atrium and the left ventricle, separated by the atrioventricular septum, also called the mitral or bicuspid septum. The right side is divided into the right atrium and right ventricle, separated by the tricuspid septum.

The main septum, where there should be no communication after birth, extends from the base to the apex. The orifices of the chambers are: the right atrium (opening for the superior and inferior vena cava), left atrium (four separate openings for the four pulmonary veins), right ventricle (the pulmonary orifice), and left ventricle (the aortic orifice).

The heart acts as a pump to circulate blood through the blood vessels. The pumping motion of the heart is divided into a contraction period (systole) and dilatation period (diastole).

The heart is more or less cone shaped and measures approximately 3½ inches in length, 3½ inches in width and 2½ inches in depth. It is enclosed in a double-walled, fibrous sac called the pericardium, and is situated obliquely in the middle mediastinum largely to the left of the medium plane. The base of the heart is directed upward, backward, and to the right; its apex, which rests on the diaphragm and against the anterior chest wall, is directed downward and to the left.

A rapidly circulating contrast medium, which is injected by the radiologist, re-
ANGIOCARDIOGRAPHY—ADAIR

requires a sterile field and a special minor surgical pack. The preparation of the surgical pack, in most hospitals, is the responsibility of the technologist in charge and consists of the routine minor surgical pack used in hospitals.

It is the responsibility of the radiologist to check all emergency equipment and to direct the technical staff to emergency stations in order to cope with the many difficulties which may occur during this procedure. The radiographic room should be prepared and checked in advance by the technical staff before the actual examination is undertaken.

At our hospital, a Schonander angiocardiographic unit, imported from Sweden, is used. This complex apparatus requires the utmost attention and upkeep. The unit has been modified by the manufacturer to handle the type of film and control panels used in this country. The film designed for use in the original unit is of almost tissue-thin thickness and is of the highest quality. The original controls are rated at 1,000 milliamperes. The controls have been modified so as to make best use of the type of mechanical equipment which controls the operation of both the anteroposterior and lateral units.

The equipment is set up to accommodate cross firing. Both the anteroposterior and lateral films are exposed simultaneously but with each tube operating independently at a maximum of 132,000 British thermal heat units (BTU) per tube.

When the primary beams from the anteroposterior and lateral tubes strike the object under examination, a portion of the radiation passes through unobstructed to the other side. A large portion of the radiation does not get through but, due to atomic collisions, is absorbed, deflected, or changed in wave length. In considering a technique, this fact is of great importance.

The limit of our equipment is 400 milli-

...amperes at 115 kilovolts. This is due not only to mechanical construction but to limited milliamperage, kilovoltage, and exposure time which are dependent upon the size of the focal spot. In compiling the suggested technique chart, it is most essential that the tube rating charts be consulted each time when it becomes necessary to deviate from the chart toward higher energy levels.

The simplest device employed for the elimination of secondary radiation, a major problem in angiocardiology, is the aperture diaphragm. This consists of 3/8 inch of lead sheet with a hole cut in the center large enough to permit the passage of a flow of x-ray photons and sufficient in diameter to cover the largest film area desired at the shortest focal-film distance. This diaphragm is located directly under the tube housing and centered to the tube window. A great improvement in film quality will be effected by using a diaphragm.

A special cone of lead sheet has been devised for the specific purpose of eliminating unnecessary secondary radiation. This cone is used with the anteroposterior tube stand and covers a 14x14-inch film at a 40-inch target-film distance.

The lateral tube has an adjustable lead leaf diaphragm imported from Germany which limits the size of the field projected onto the lateral films. The use of white spot lights, which are projected through a reflector type geometrical prism, outline the area to be examined. The lateral films are taken at a 40-inch target-to-film distance.

The grids used with a Schonander are those supplied by the manufacturer. When additional grids are used, adjustments in technique must be made. An example is the cross-hatching of stationary grids to permit better visualization of detail in radiographing large subjects.

In measuring the patient for the sug-
ggested technique chart, it is imperative that a point on the median plane, midway between the suprasternal notch and the xiphoid on the gladiolus, be used. For the latter, with the patient in the supine position and the hands and arms well extended over the head, a point on the lateral margin of the thoracic cage in the region of the axilla is selected.

After checking the patient for premedication, the bakelite surface table, covered with a polyurethane sponge mat, is adjusted to the anteroposterior machine. A point on the mid-sternum is centered to the 14x14-inch square grid on the anteroposterior machine. The lateral landmark is adjusted to the lateral 14x14-inch grid.

A scout radiograph is taken after the loaded magazines have been advanced into the ballistic position. The film is developed by time-temperature processing and checked by the radiologist for technique and positioning.

The hand switch is adjusted for serial exposures, and the machine is adjusted for the final run of twenty-seven anteroposterior and twenty-seven lateral films. The films have been placed individually into slots incorporated into the loading boxes.

After a blood-circulating time is obtained by the radiologist, the timing panel is adjusted according to his instructions. Films can be exposed from one and a half to six per second at any intervals desired by properly adjusting the timing panel. American-made, time-recording devices are placed in the anteroposterior and lateral fields. The timing discs are radiopaque and are visible on the finished radiograph. The timers record on each film the interval at which the films have been run through the units, excluding any intervals which may have been set deliberately into the timing.

Having checked and rechecked all emergency stations, emergency equipment, mechanical equipment, and control panels, the technician prefaces the final "run" for "firing." After the anodes of the x-ray tubes are rotating for ten seconds, the radiologist injecting the opaque medium counts as he injects—one, two, three. On the count of two, the serial exposures begin; on the count of three the opaque medium is injected as rapidly as possible.

The serial films are removed from the receiving boxes provided for in both the anteroposterior and lateral machines. Each film is marked with a skin pencil from 1 to 27 before developing begins. This is a means of checking the timing devices and keeps films in proper sequence while viewing them wet.

Emergency controls are provided for in the mechanical construction of the machine. On top of the timing panel, four small red lights are located. Each indicates one stage in the mechanical procedure of the angiocardiographic examination. The first light, from left to right, indicates when the main power line is on. This takes seven minutes to light up after both main switches on the main controls have been turned on. The second light indicates the ballistic stage or position of the loaded magazines. The third light indicates that the anteroposterior magazine is loaded and the receiving box is open. Likewise, the fourth light indicates that the lateral magazine is loaded and in position and that the receiving box is open. All four lights must be in the "on" position before an exposure can be made. If any difficulties develop, they can be located easily by checking the lights on the timing panel.

The unit is also equipped with a hand emergency stop. This causes the unit to discontinue operation and cuts off the electrical supply to the machine. Should this means of control fail, the circuits can be interrupted by opening any of the doors of the unit.

(Continued on Page 448)

THE X-RAY TECHNICIAN
for their certificates should give some considera-
tion to this explanation and rest assured that
the Registry office is doing everything within its
power to speed their delivery. They will be
forwarded to the technicians immediately when
they are received from the engrosser. It would
be permissible, however, to make inquiry to the
Registry if the certificate has not arrived after
a lapse of three months or more. It is always
possible that a change of address or a misdirec-
tion has taken place.

FALL EXAMINATIONS

The regular fall examinations by the American
Registry of X-Ray Technicians will be held the
week end of November 2. Applications must be
postmarked not later than midnight, September
15, to be considered for this examination. Appli-
cants who expect to be eligible not later than
January 7, 1958, can be considered for the No-

tember examination providing the applications
are submitted within the deadline. In such in-
stances, a follow-up investigation will be made
to see that the requirements have been met be-
fore a certificate will be issued.

REGISTRY QUESTIONS ARE
PRIVATE PROPERTY

Word has reached the Registry office that
copies of previous Registry examinations have
been mimeographed and widely distributed in
some parts of the country. It has been made plain
on previous examinations that these questions
were not to be copied, and it has been a policy
of the Registry Board for many years not to
distribute copies of their previous examinations.
One reason for this is to prevent cramming by
an applicant on a few selected subjects rather
than a general background of study of which
the examination questions are intended to be only
a sampling. Due to the newness of the objective
type Registry examination questions the backlog
in the master list is not sufficient for distribution.
Many of the questions will of necessity be used
over and over again and it is hardly a fair
proposition to allow specific questions to be
studied by technicians in one sector and denied
to those in another. As of the current examina-
tion the actual questions used by the Registry
will be copyrighted and can be reproduced enti-

tely or in part only upon written consent from
the Registry office. It is well understood that the
actual subject matter of the examination questions
is in the public domain. The Registry is con-
cerned only with the reproduction of their specific

questions in the manner in which they were used
by the Registry so that a technician may mem-
orize the questions and answers without actually
adding to his stock of real knowledge. It is for
the good of the technician and the Registry that
these regulations have been adopted and it is
earnestly hoped that all those connected with
the examinations will co-operate to the fullest
extent. Any technician who used forbidden means
of attaining examination information and becom-
ing certified should derive very little satisfaction
from a certificate obtained in this manner.

ANGIOCARDIOGRAPHY

(Continued from Page 402)

The technical factors used are as follows:

9-26 cms. 68-118 kv.p., 400 ma., 1/120 second
27-30 cms. 108-117 kv.p., 400 ma., 1/60 second
31-34 cms. 107-116 kv.p., 400 ma., 1/30 second

This paper constitutes a brief review of the
equipment and techniques used in angio-
cardiography with the Schonander bi-
plane angiocardiographic unit. Although
operation, control, and technical factors
are difficult to control, the results are re-
darding and have in many instances pro-
longed the life span for patients who pre-
viously had little hope of survival. The
unit can also be adapted for use in cerebral
angiography, abdominal and thoracic aort-
ography.

HELPFUL HINT

No magazine is complete without at least one
recipe. Of course, the film manufacturers prob-
lably get frustrated at the idea of anyone’s remov-
ing the beautiful blue color from the cellu-
loid base. But when utilized to cover charts, it is
more practical to have the film clear.

Recipe for celluloid-bleaching blue film (as
done at St. Benedict’s in Ogden)—1 cup vinegar;
3 cups of bleach.

Place the above mixture in a container large
enough to cover the cleared blue base to be
bleached. Place the film in this mixture for about
five to ten minutes and the coloring is sponta-
neously removed. Rinse the film in cold water and
wipe dry.—Ute Rays, Fall 1956.