VALUE AND LIMITATIONS OF DIFFERENT PROJECTIONS OF THE LEFT VENTRICULAR ANGIOGRAPHY IN THE ACCURATE DIAGNOSIS OF CONGENITAL AND ACQUIRED ADULT HEART DISEASE

THESIS

Submitted In Partial Fulfilment For
The Master Degree (CARDIOLOGY)

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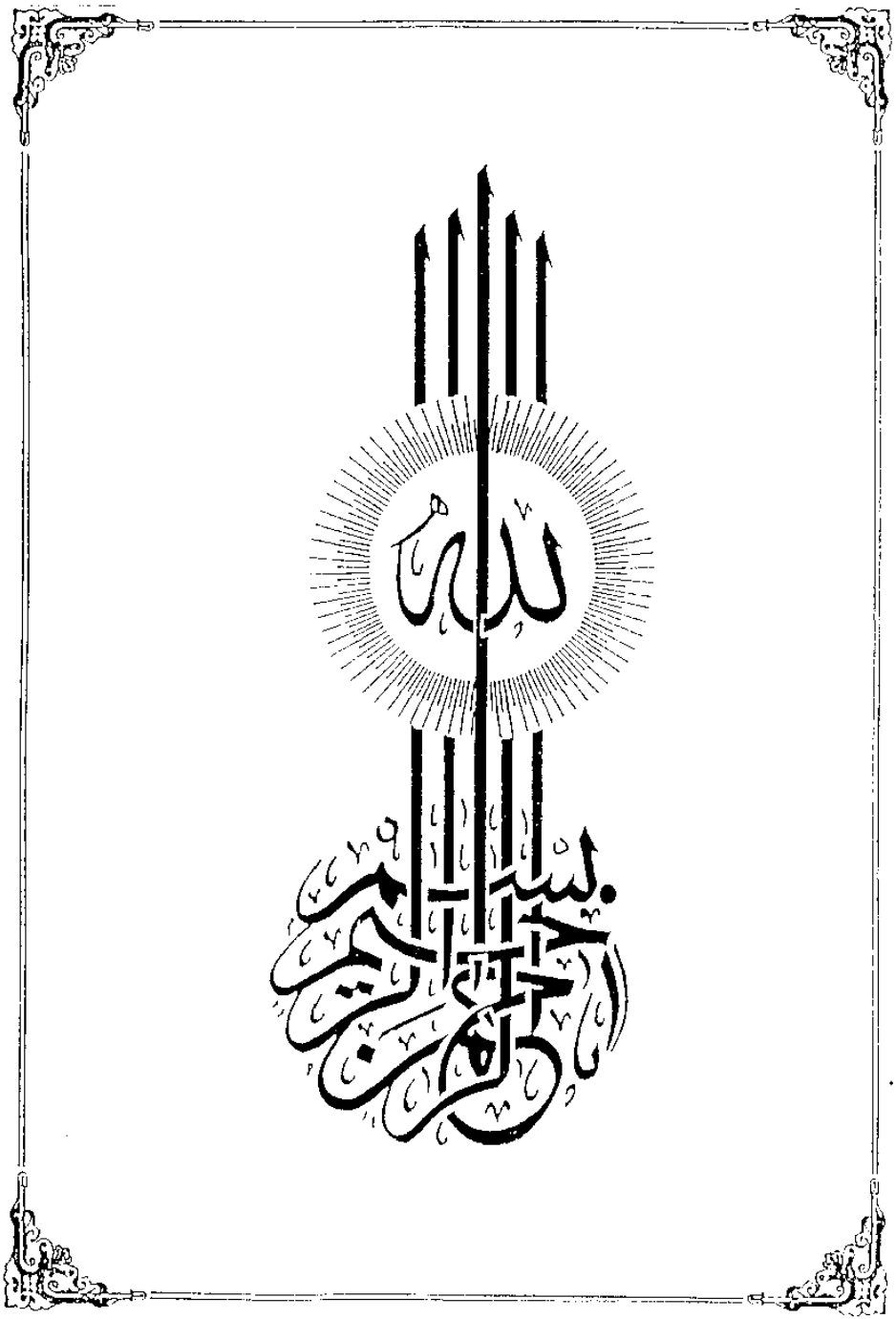
(1984)



A C K N O W L E D G E M E N T

I offer my deepest gratitude to Prof. Dr. H. Demerdash Head of Cardiology Department, Ain Shams University .

I do not find words to thank Prof. Dr. M.K. El-Dayem to whom I feel most endebted because without his essential guideness, help ideas and constructive criticism, this work would have never come to light .

I would like to express my deepest thanks to Prof. Dr. L. Galal, for her kind help and endless cooperation throughout the course of this work .

Lastly, but not least, I would like to thank my colleagues who were really , as expected , of great help throughout this work .

C O N T E N T S

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INTRODUCTION

A N G I O G R A P H Y

Angiography is a procedure in which contrast substance is injected into a systemic vein, a cardiac chamber or the pulmonary artery so that its passage through a part or all of the heart and great vessels can be followed by serially exposed films[1] .

History of The Procedure

Cardiac catheterization was first performed (and so named) by Claude Bernand (1844) . The subject was a horse and both right and left ventricles were entered by a retrograde approach from the jugular vein and carotid artery .

Forssman (1929) succeeded in threading a ureteral catheter into an elbow vein of a living person - himself and by appropriate manipulation passed the tip into the right atrium . Shortly thereafter, the same investigator (1931), using dogs, found that if 50 % Uroselectan was injected rapidly into the catheter and a single X-ray film was exposed at the end of the injection, the right heart chambers and the pulmonary artery and its branches

could be visualized; also the dogs suffered no ill effects. Encouraged by these experiments, Forssman tried the procedure on himself, but twice failed to demonstrate the right heart or pulmonary artery . The amount of contrast substance was too little and the lumen of the catheter was too small to permit a significant concentration to reach the right atrium .

The Portuguese workers, Moniz et al. (1931), used essentially the same technique as Forssman, except that a concentrated solution of sodium iodide was substituted for Uroselectan, and obtained satisfactory visualization of the right heart chambers and pulmonary arterial system first in animals and later in man . Thus, they were able to study the arterial pattern in both normal and abnormal lungs, and probably the greatest contribution of the procedure was to demonstrate the relationships of the pulmonary artery to complex hilar shadows . Later, it was found that equally good results could be obtained by injecting the sodium iodide into a peripheral vein, and the procedure was called l'angiopneumographie . A short time later, Conte and Costa (1933) attempted to shorten the injection time by placing two catheters into the right atrium (a catheter was inserted into the vein of each arm).

In 1937, Castellanos et al published an account of their use in children and infants of a procedure which they called l'angiocardiographia radio-opaca . Their technical contributions were (1) the use of large bore trocars for the more rapid introduction of the contrast substance into the veins, (2) the use of first 35 and then 50 % perabrodil (Diodrast), and (3) the adaptation of the procedure for use in infants and children where good radiographic contrast was more easily obtained . This procedure was used on a number of patients with congenital heart disease and frequently demonstrated interatrial and interventricular septal defects . The left heart chambers and the aorta were still not visualized reliably, however, except in those instances in which the contrast substance passed from the right to the left side through a septal defect . Four - chamber angiocardiography arrived in 1939 following a description by Robb and Steinberg of a technique which produced visualization of all the heart chambers, as well as the great vessels, in a higher percentage of examinations . After considerable studies, these workers decided that 70 % Diodrast was the most satisfactory contrast substance available at that time and that it was well tolerated in doses up to 1 mg / kg of body weight .

They also developed a large bore cannula which, when used with a special syringe tip of equal diameter , permitted the injection of 50 ml of Diodrast within two seconds or less . Chavez et al. (1947) returned to the use of a catheter as a means of introducing the contrast substance into the right side of the heart . A further refinement of this procedure introduced by A. Jonsson et al. (1949) is the use of a manual pump which greatly increases the injection rate . Manual pumps have now been replaced by power - driven, and sophesticated semi-automatic injectors . The introduction of catheters into the right side of the heart and aorta for physiologic and hemodynamic investigations was popularized by Cournand and Ranges (1941), and it was rather easy step to follow this procedure by selective injection of contrast substance . It was soon found that it was necessary to substitute other types of catheters for the Cournand catheter in order to produce safe and satisfactory selective visualization of the right ventricle and pulmonary artery .

The approach to the left side of the heart and the aorta underwent a considerably longer evolutionary development.

Rousthoi (1933) inserted catheters into the right carotid arteries of rabbits and threaded them into the ascending aorta and left ventricle . Following the injection of the Thorotrast, he obtained visualization of the left ventricle, the thoracic aorta and particularly the coronary arteries . Nuvoli (1936) was the first to perform aortography and left ventriculography successfully in man by inserting a strong, large bore needle directly through the sternum into the ascending aorta or the left ventricle . Hoyos and Del Camp (1948) modified this procedure by inserting a needle through the left second anterior interspace into the aortic arch. Ponsdomenech and Nunez (1951) employed a similar route by inserting a long needle through the chest wall from a paraxyphoid position usually into the left ventricle and injecting the contrast substance directly into this chamber . The same type of approach was explored by Lehman et al. (1957) .

Following the development of techniques for retrograde insertion of catheter into the aorta and left ventricle , the transternal and transthoracic approach has been largely abandoned . Costellanos and Pereiras (1942)

injected contrast substance in a retrograde direction into the brachial artery . The direction of blood flow was temporarily reversed so that a sufficiently high concentration of the contrast substance entered the aorta so as to permit quite satisfactory visualization . Radner (1948), dissatisfied with direct puncture of the aorta, experimented with insertion of a uretral type of catheter into the right or left radial artery and guiding the tip into the ascending aorta under fluoroscopic control. Using the pressure pump developed by Jonsson (1949) a much greater flow rate of contrast substance could be obtained . Seldinger (1953) described a most useful improvement whereby a catheter larger than the puncture needle could be inserted into either an artery or a vein, this procedure eliminated the need for arterial repair and cut down procedures and stimulated the use of retrograde aortography and the approach to the left ventricle by the transaortic route . Transeptal approach to the left side of the heart particularly the left atrium was described by Ross (1959) and Braunwald (1960) . Image amplification and television monitor viewing became more widely available in the early fifties,

also image amplification, opened up the development of cinefluorography as a practical recording vehicle . Concurrently, over the past 20 years, large film changers have steadily improved .

Thus, it is seen that the present eminent status of cardioangiography is due to a convergence of several lines of advance occurring over a period of approximately 50 years(1) .

History of the used projections :

Early during this period, the selected projections for cardiac imaging were only frontal and lateral views, but the oblique views (right anterior oblique and left anterior oblique) were added in the late fifties .

There has recently been considerable interest in specific angiocardiographic views . This has been made possible by the general acceptance of image intensifier cine-angiocardiography with automatic dose control which ensures a correctly exposed film whatever the projection, and stimulated by the development of self angulating radiographic installations . Yet the principle of compound