APPLICATIONS OF ULTRASONIC CONTRAST MEDIA IN DIAGNOSTIC ULTRASOUND TECHNIQUES

ESSAY

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Master degree in Diagnostic Radiology

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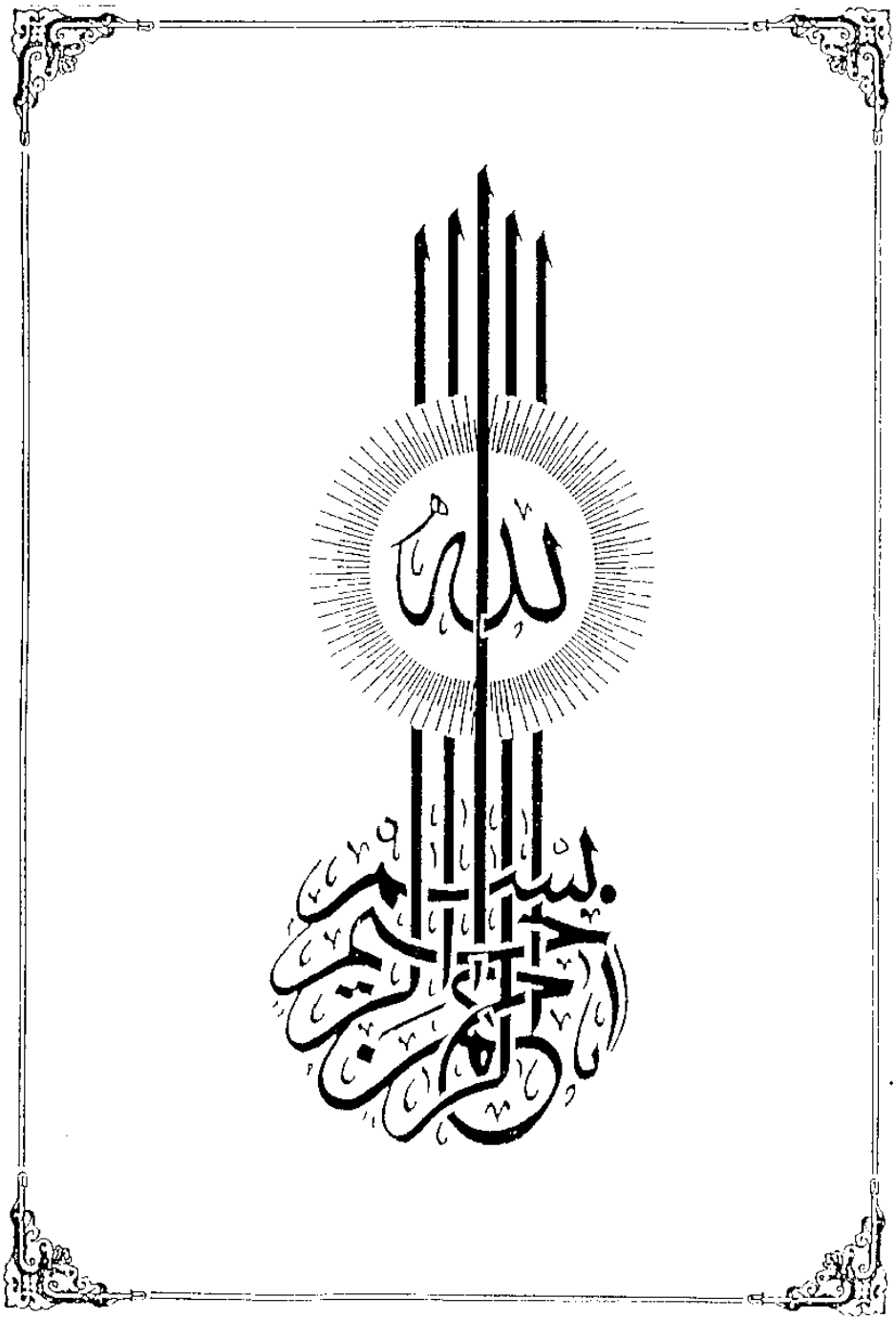
TO MY PARENTS

They gave me life
And still give me the
Reason for.



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INTRODUCTION

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Though ultrasonography (US) has been -for long- a powerful imaging tool, for a variety of reasons which include non-invasiveness , multiplanar imaging and relatively low cost, such modality could not take the place of other means of imaging like CT or angiography,which are superior in detecting the vascularity of examined tissues ,thus giving more information about the nature of the concerned structures.

A major step in the progress of ultrasonographic diagnosis would be achieved by the development of ultrasonic contrast media . These are given by intravenous or intra-arterial injection, to take the blood distribution of an organ or a lesion ,thus reflecting the vascularity of the examined structure *(Gramiak; Shah 1968)*.

Echogenic CM enable flow phenomena to be directly observed in B scanning ,Doppler signals to be intensified , or CM to be used as an indicator solution for determining function (e.g. contrast enhanced hystrosalpingosonography; visualization of cardiovascular shunt flows. *(Ophir J; Parker K.J. 1989)*.

The aim of this work is to review the role of different types of ultrasonic contrast media in diagnostic imaging, and to assess their value and clinical applicability in the diagnosis of various diseases.

HISTORICAL NOTES

The oldest known contrast administration technique involves the use of agitated or foamed injection solutions to produce echogenic effect in the blood during echocardiographic examinations. The first publication describing this effect appeared as early as 1968 by *Gramiak R, shah PM.*

In the following years, various injectable solution were investigated as possible contrast media for increasing contrast and in vivo life span. Various preparatory techniques were also compared (shaking; foaming under a three-way tap; foaming with US high energy, i.e. [sonification]). In several papers the superiority of the sonification method was shown in regard to bubble dimensions and the intensity of CM effect; however, it has not yet been possible to produce microbubbles in a purely liquid suspension that are reproducible and stable enough to warrant being designated as injectable CM .

An in vivo stability sufficient for attaining diagnostically relevant contrast effects after passage through pulmonary capillaries has yet to be achieved . For this reason, the use of CM of this type was limited to venous vessels, the right ventricle and body cavities.

With the help of a special sonification technique and by using human albumin as a solution medium, it has been possible to produce air-filled microspheres that survive pulmonary capillary passage and produce left-ventricle contrast effects. Individual preparations are cited in the

literature *(Reisner AS, et al 1989)*, but the industrial development of this type of echogenic CM is represented only by Albunex *(Einstein SB, Cheirif J, et al 1990)*. The preparation is being clinically developed in the United States (Molecular Biosystems, Mallinckrodt), Europe (Nycomed) and Japan (Shionogi) for use as an echocardiographic CM for B (sector) scanning.

The first industrial development of echo-enhanced CM, which began about 10 years ago, is based upon suspensions containing microparticles of specially produced galactose particles. This development was successfully concluded with the marketing of SH U 454 (Echovist). A further preparation (SH U 508) is currently being tested.

An identical principle underlies both SH U 454 and SH U 508 Microparticle granules are suspended shortly before use in specially produced galactose; the suspension is created by shaking these granules in either a galactose solution (Echovist) or in sterile water (SH U 508 A). After the milky-white suspension of microbubbles is injected and makes its passage as a bolus, the blood becomes temporarily echogenic until these acoustic microstructures have been dissolved in the bloodstream *(Schielf R 1988)*.

After intravenous injection, SH U 454 (Echovist) dissolves after leaving the right ventricle, as a result of mixing with and being diluted by the blood, before reaching the left ventricle. It is thus suitable for the contrast echocardiographic examination of the right ventricle (and the venous vessel system) by means of B-mode (sector) scan and Doppler. It is also used as an echogenic indicator solution for the sonographic visualization of the patency of the fallopian tubes (*Schlief R, Deichert U 1991*).

SH U 508 possesses greater intravascular stability than SH U 454, something achieved through a minor galenic change (using physiological fatty acid as an additive). This results in an increase in echogenicity that survives the pulmonary passage after intravenous injection and thus remains, in fact, in the systemic arterial vascular bed. With the bloodstream echogenic during bolus passage, an echogenic contrast imaging of the right and left cardiac cavities in sector scan may be achieved, even with a smaller doses, Doppler signal intensity is enhanced.

PHYSICAL PRINCIPLES