HARVARD MEDICAL SCHOOL
TEACHING HOSPITAL

# Masood Akhtar, MD Memorial Lecture

## AF-VT-VF Summit Chicago 2019

**Jeremy N. Ruskin, MD**
**Founder and Director Emeritus, Cardiac Arrhythmia Service**
**Alomran Endowed Chair in Cardiology, Massachusetts General Hospital**
**Professor of Medicine, Harvard Medical School**

MGH 1811
MASSACHUSETTS GENERAL HOSPITAL
CORRIGAN MINEHAN HEART CENTER

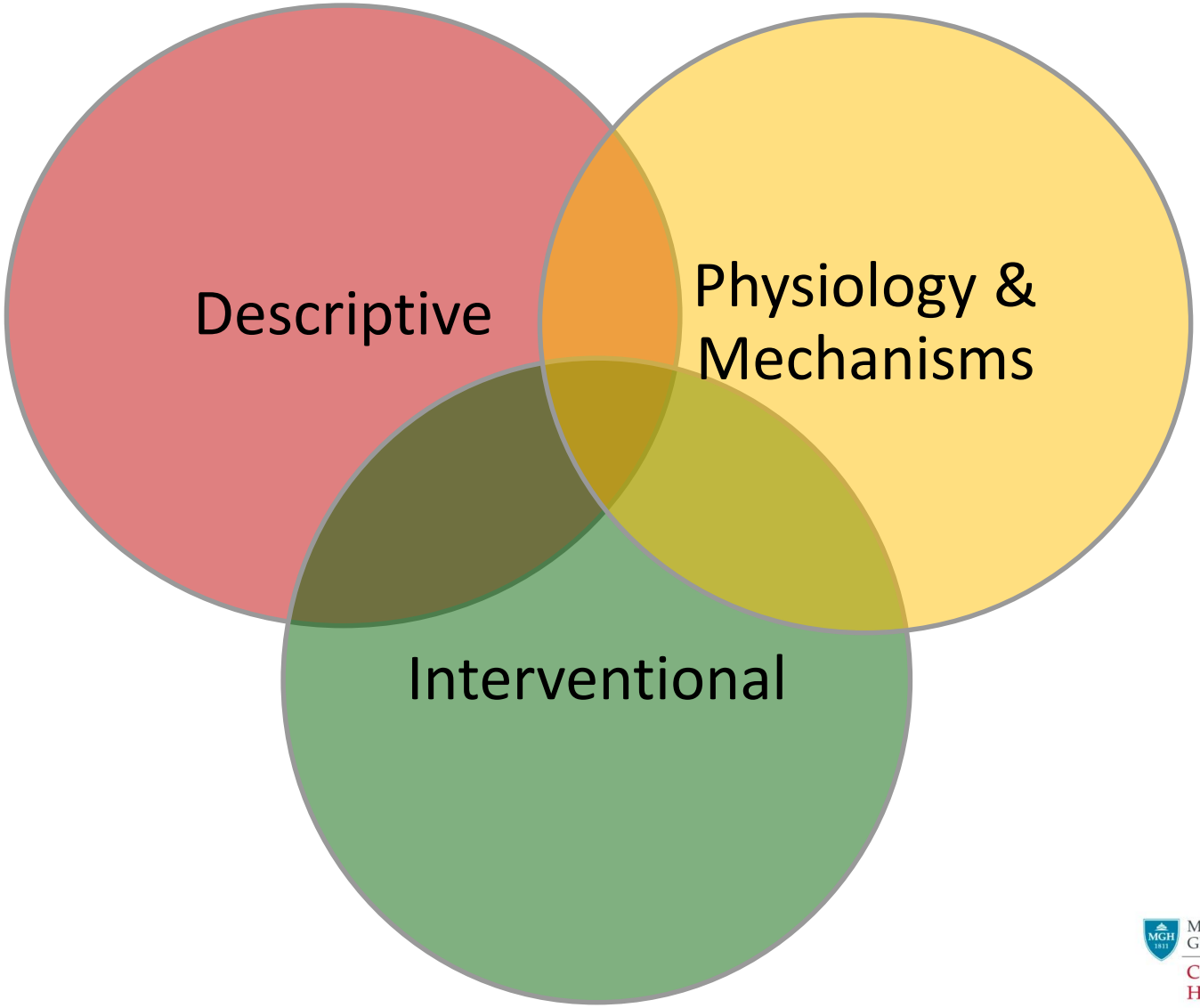
# Masood Akhtar, MD

1943 - 2019

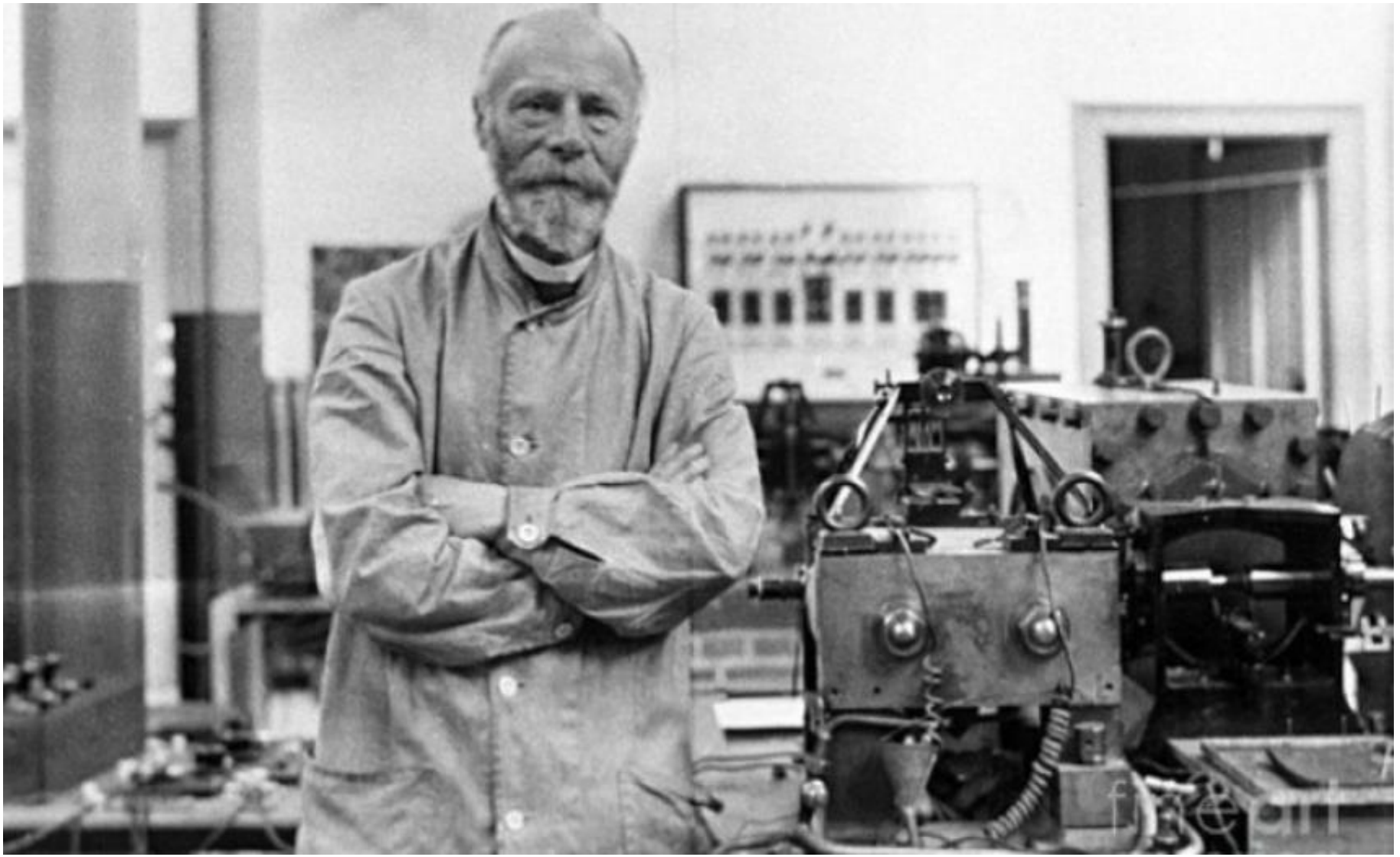
# Masood Akhtar, MD
## 1943 - 2019

- Born 1943 Bannu, Pakistan
- King Edward Medical College, Lahore, Pakistan
- 1968-1971 Residency in Medicine, Buffalo, NY
- 1971-1977 USPHS Hospital, Staten Island, NY
- 1977-2019 The Milwaukee years

# Clinical Cardiac Electrophysiology Evolution 1969-2019

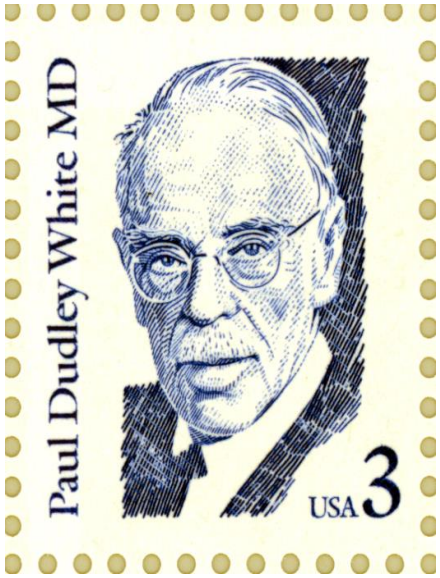



History of The Cardiological Doctrines - Diego Rivera 1944 Institute of Cardiology Mexico City



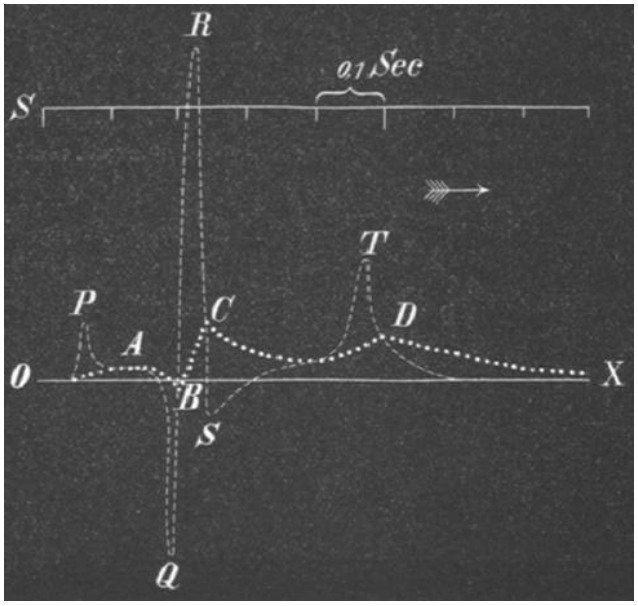
**Willem Einthoven (1860-1927)**
**Professor of Physiology, University of Leiden, The Netherlands**
**Nobel Prize in Physiology and Medicine 1924**

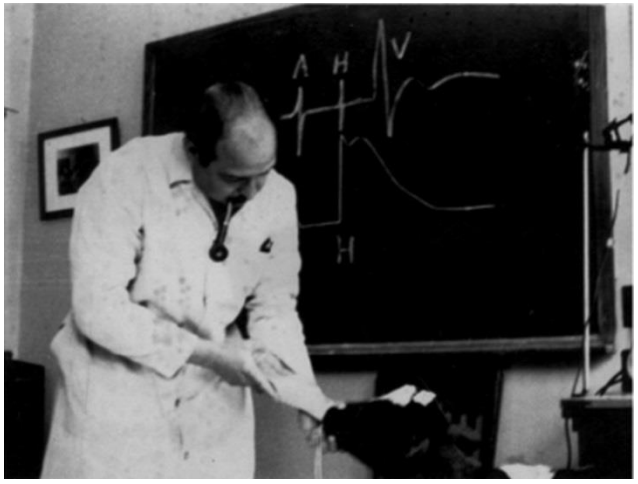
# ECG Laboratory-Massachusetts General Hospital 1914

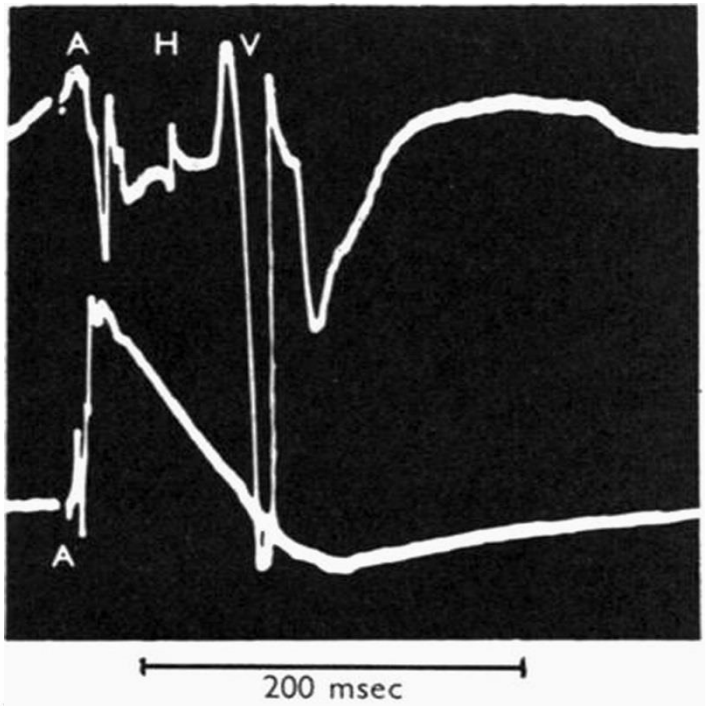


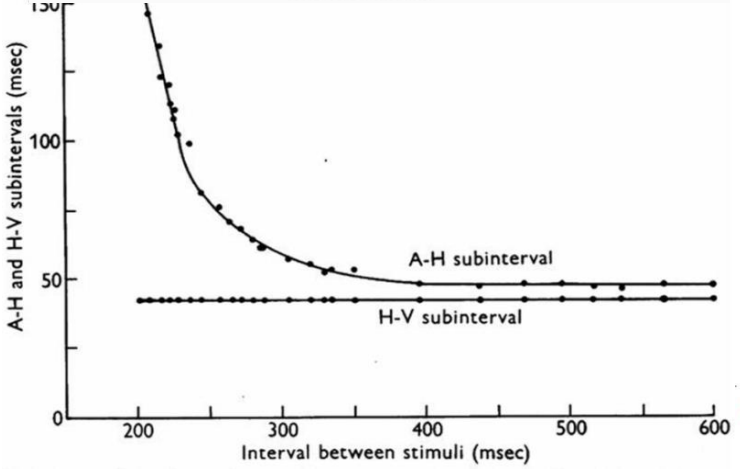

MASSACHUSETTS GENERAL HOSPITAL
CORRIGAN MINEHAN HEART CENTER

# First His Bundle Recording - Jesus Alanis, MD 1958
## National Institute of Cardiology, Mexico City




Alanis, J et al. Electrical activity of the bundle of His. J. Physiology; 142:127, 1958.

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

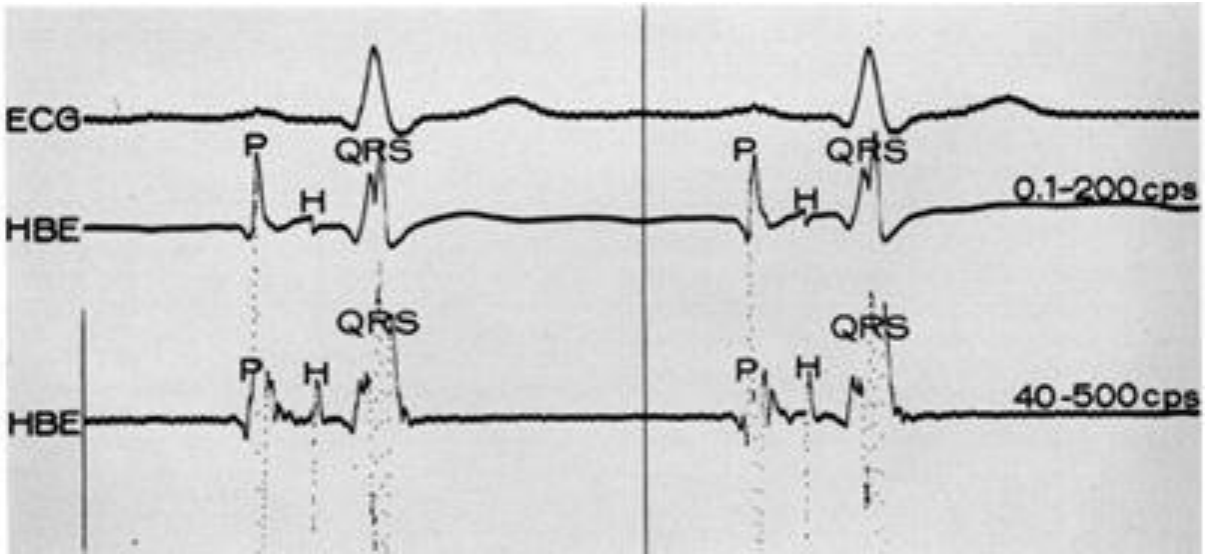
American Heart Association

# Catheter Technique for Recording His Bundle Activity in Man

BENJAMIN J. SCHERLAG, SUN H. LAU, RICHARD H. HELFANT, WALTER D. BERKOWITZ, EMANUEL STEIN and ANTHONY N. DAMATO

*Circulation*. 1969;39:13-18
doi: 10.1161/01.CIR.39.1.13
*Circulation* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 0009-7322. Online ISSN: 1524-4539



# Anthony N. Damato, MD (1930-2001)
## U.S. Public Health Service Hospital Staten Island, NY

# U.S. Public Health Service Hospital
# Staten Island, New York (1831-1981)

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

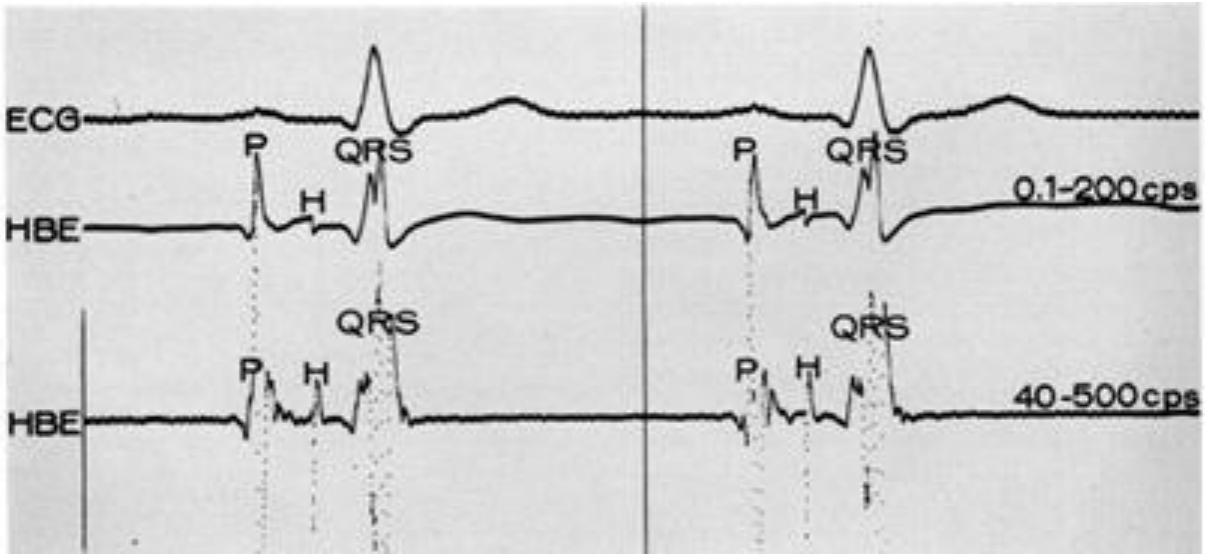
American Heart Association

# Catheter Technique for Recording His Bundle Activity in Man

BENJAMIN J. SCHERLAG, SUN H. LAU, RICHARD H. HELFANT, WALTER D. BERKOWITZ, EMANUEL STEIN and ANTHONY N. DAMATO

*Circulation*. 1969;39:13-18
doi: 10.1161/01.CIR.39.1.13
*Circulation* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 0009-7322. Online ISSN: 1524-4539



Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

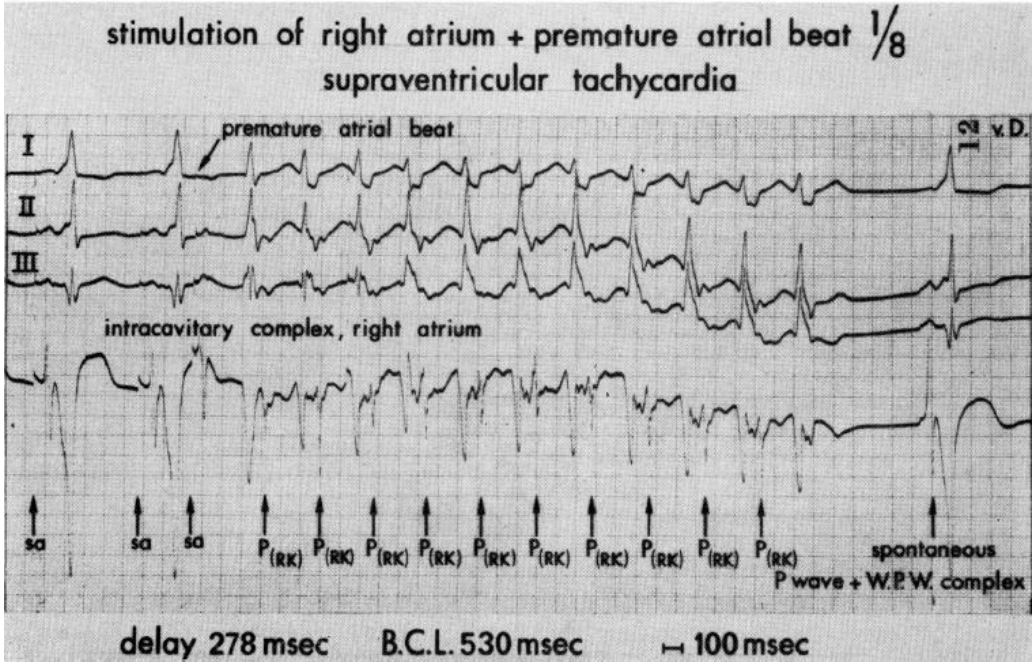
American Heart Association®

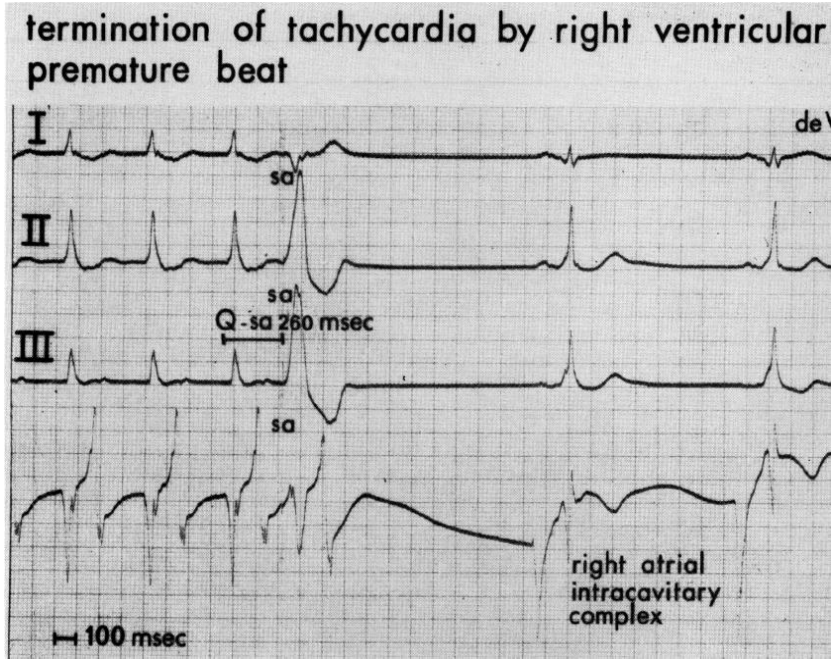
# The Role of Premature Beats in the Initiation and the Termination of Supraventricular Tachycardia in the Wolff-Parkinson-White Syndrome

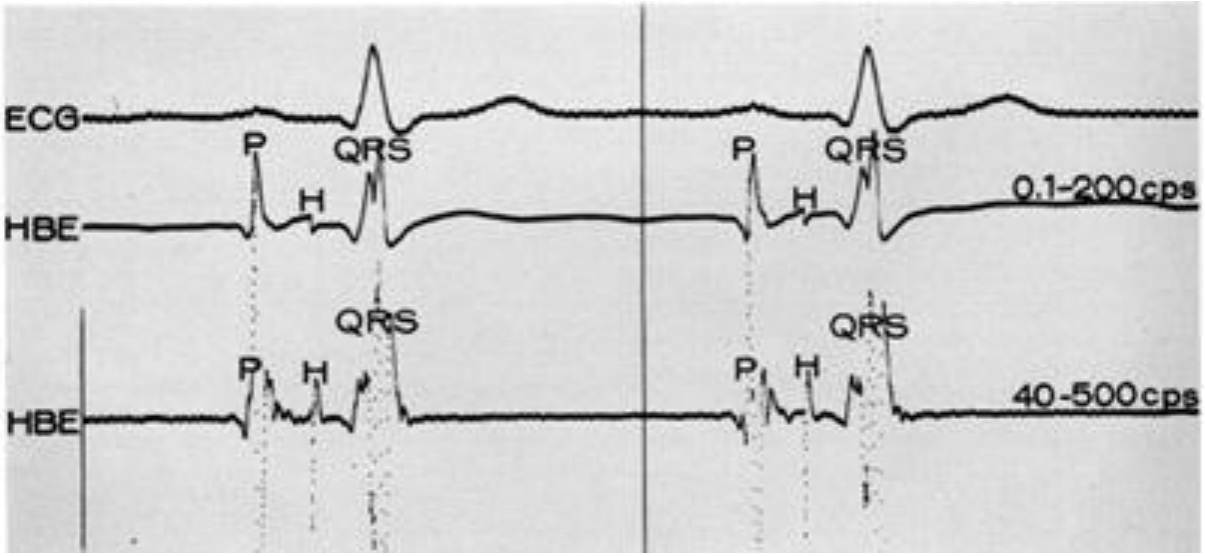
D. DURRER, L. SCHOO, R. M. SCHUILENBURG and H. J. J. WELLENS

*Circulation*. 1967;36:644-662
doi: 10.1161/01.CIR.36.5.644
*Circulation* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

Print ISSN: 0009-7322. Online ISSN: 1524-4539

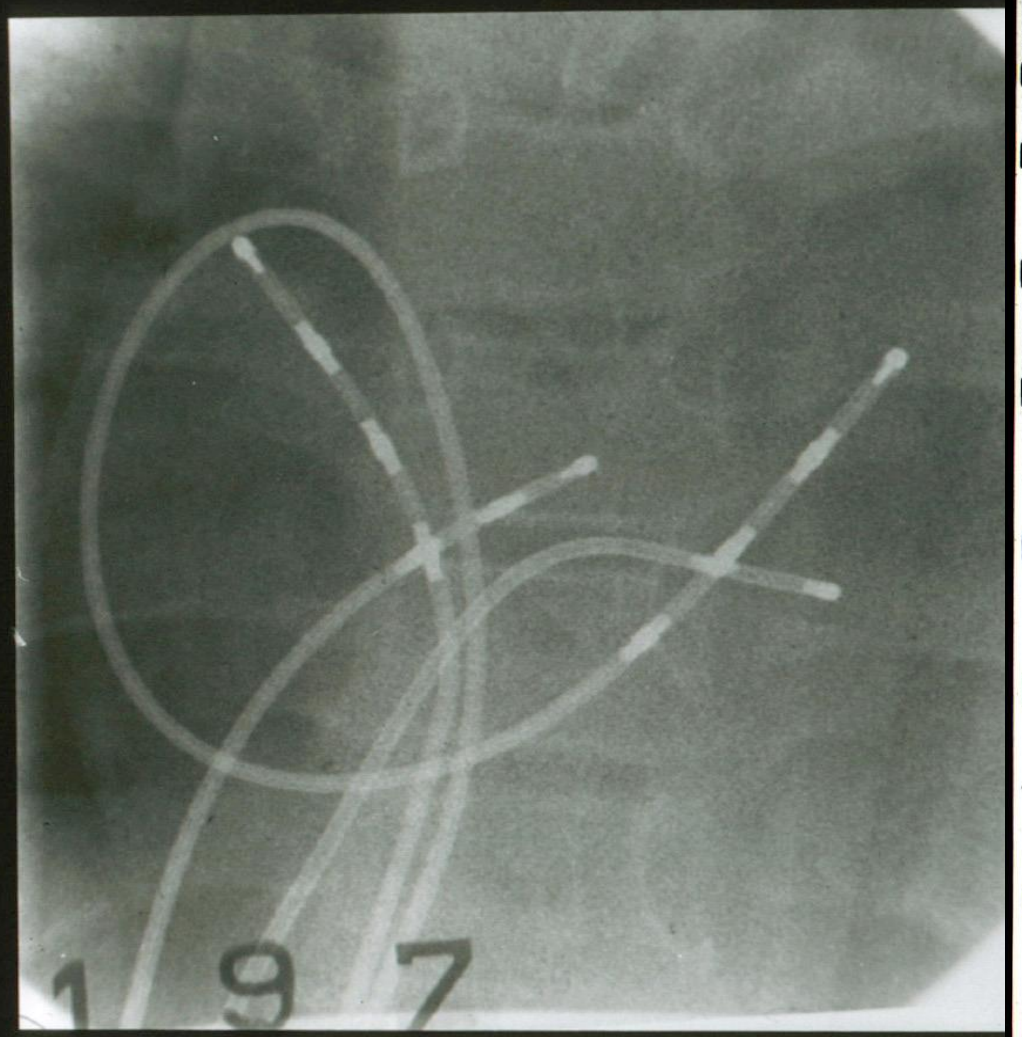


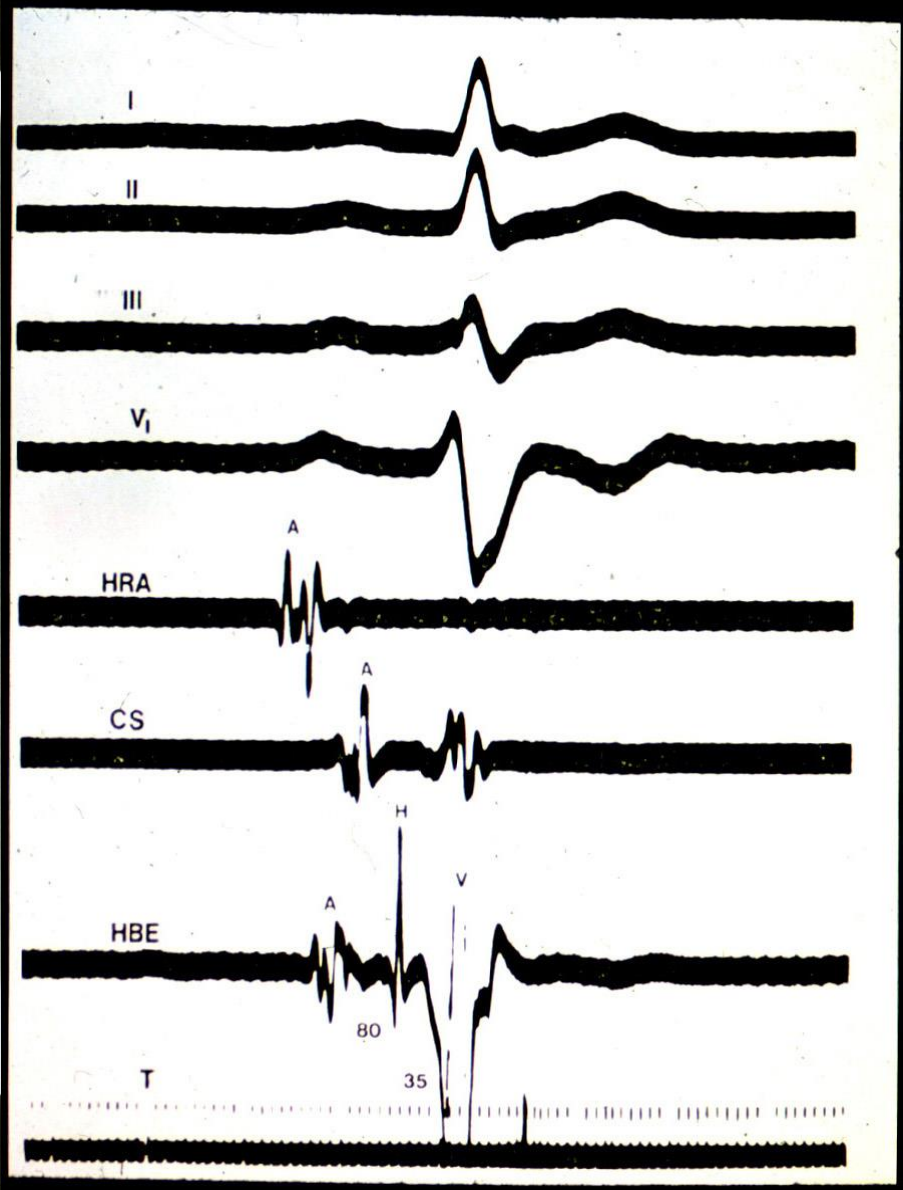





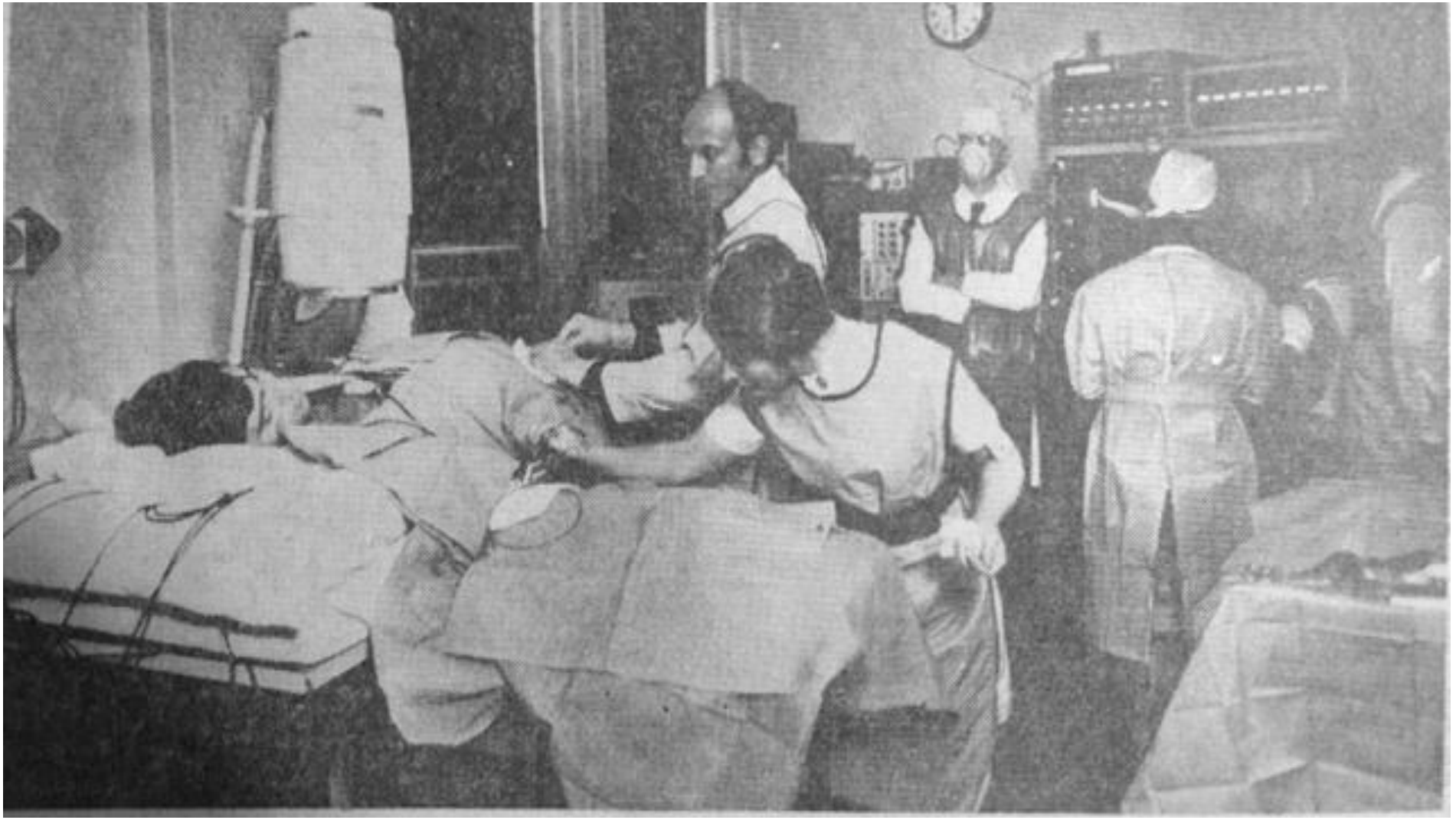

The His bundle recording technique is now being used in our laboratory in patients for diagnostic, physiological, or both types of investigation.

Scherlag & Damato Circulation 1969; 39:13-18.


197


I
II
III
V1
A
HRA
A
CS
H
A
V
HBE
80
T
35

# USPHS Hospital Staten Island, NY 1973



# Anthony N. Damato Laboratory
# USPHS Staten Island (1960-1981/1967-1977)

- Ben Scherlag - University of Miami; University of Oklahoma
- Andrew Wit - Columbia University
- Ken Rosen - University of Illinois
- Bruce Goldreyer - University of Pennsylvania
- John Gallagher - Duke University Medical Center
- Mark Josephson - University of Pennsylvania; BIDMC
- William Batsford - Yale University Medical Center
- Jeremy Ruskin - Massachusetts General Hospital
- Anthony Gomes - Mt. Sinai Medical Center NY
- Masood Akhtar - University of Wisconsin

# Clinical Intracardiac Electrophysiology
# The Early Years

- Programmed electrical stimulation techniques
- Reliable catheter based recording of the His Bundle EGM in humans
- Refractory periods (RRP, ERP, FRP) of cardiac tissues
- Functional properties of the normal and abnormal AV and VA CS
- Effects of autonomic NS and drugs on functional properties of AVCS
- Localization of site(s) of AV blocks; prediction of outcomes
- Decremental and concealed conduction; reentry
- Differentiation of reentry from triggered and automatic rhythms
- Mechanisms and anatomic substrates of SVTs and VTs

# Clinical Cardiac Electrophysiology Interventional Techniques

- Surgical Correction of WPW 1968
- Map Guided Surgery for VT 1980
- DC Ablation of AV Junction for SVA 1982
  & Accessory Pathways 1984
- ICD First implant & FDA approval 1980/1985
- Surgical Correction of AF (MAZE) 1987
- RF Ablation for AVNRT 1989
- RF Catheter Ablation for WPW 1991
- RF Ablation for Atrial Flutter 1992
- RF Catheter Ablation for AF 1998
- Mechanisms/Energy Sources/Advanced Mapping

# Masood Akhtar, MD
# USPHS Staten Island (1971-1977)

- Effects of vagus on the human AV Conduction System
- Unusual gap phenomena and gaps during retrograde conduction
- Comparative analysis of antegrade and retrograde conduction in humans
- Functional bundle branch blocks
- Effect of atrial stimulation site on properties of the AV node
- Iatrogenic electrocardiographic patterns during EP studies
- Antegrade and retrograde conduction patterns in different forms of PSVT
- Effects of abrupt changes in cycle length on EP properties of HPS
- Demonstration of reentry within the His Purkinje System and elucidation of reentrant circuit utilizing right bundle branch and His bundle recordings
- Bundle branch reentry VT (BBRVT) – mechanisms and curative ablation
- Preexcitation; Unexplained syncope; ICDs; SP ablation in AVNRT

# Demonstration of Re-entry within the His-Purkinje System in Man

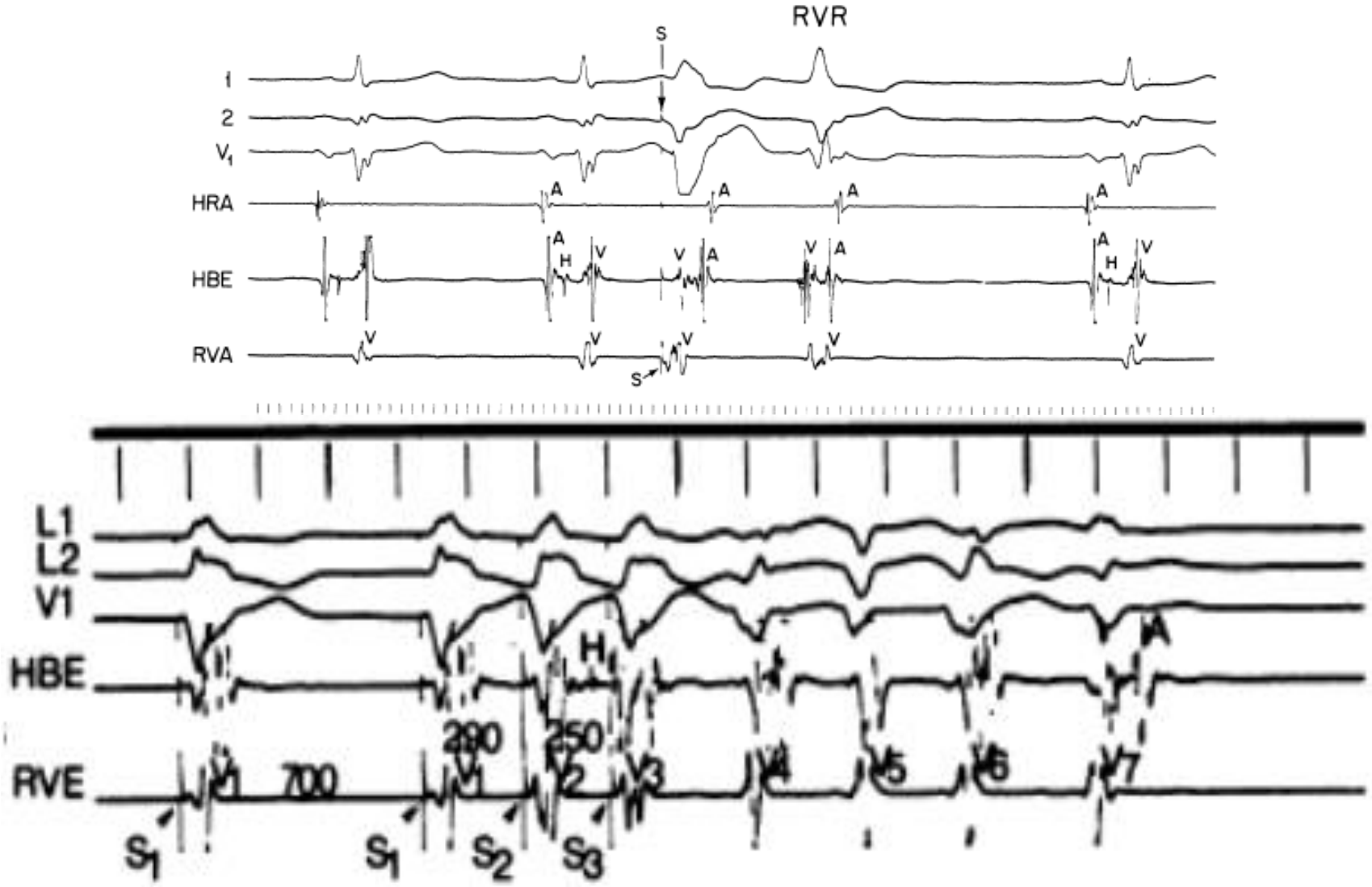
*By* Masood Akhtar, M.D., Anthony N. Damato, M.D., William P. Batsford, M.D., Jeremy N. Ruskin, M.D., J. Bimbola Ogunkelu, M.D., and Guillermo Vargas, M.D.

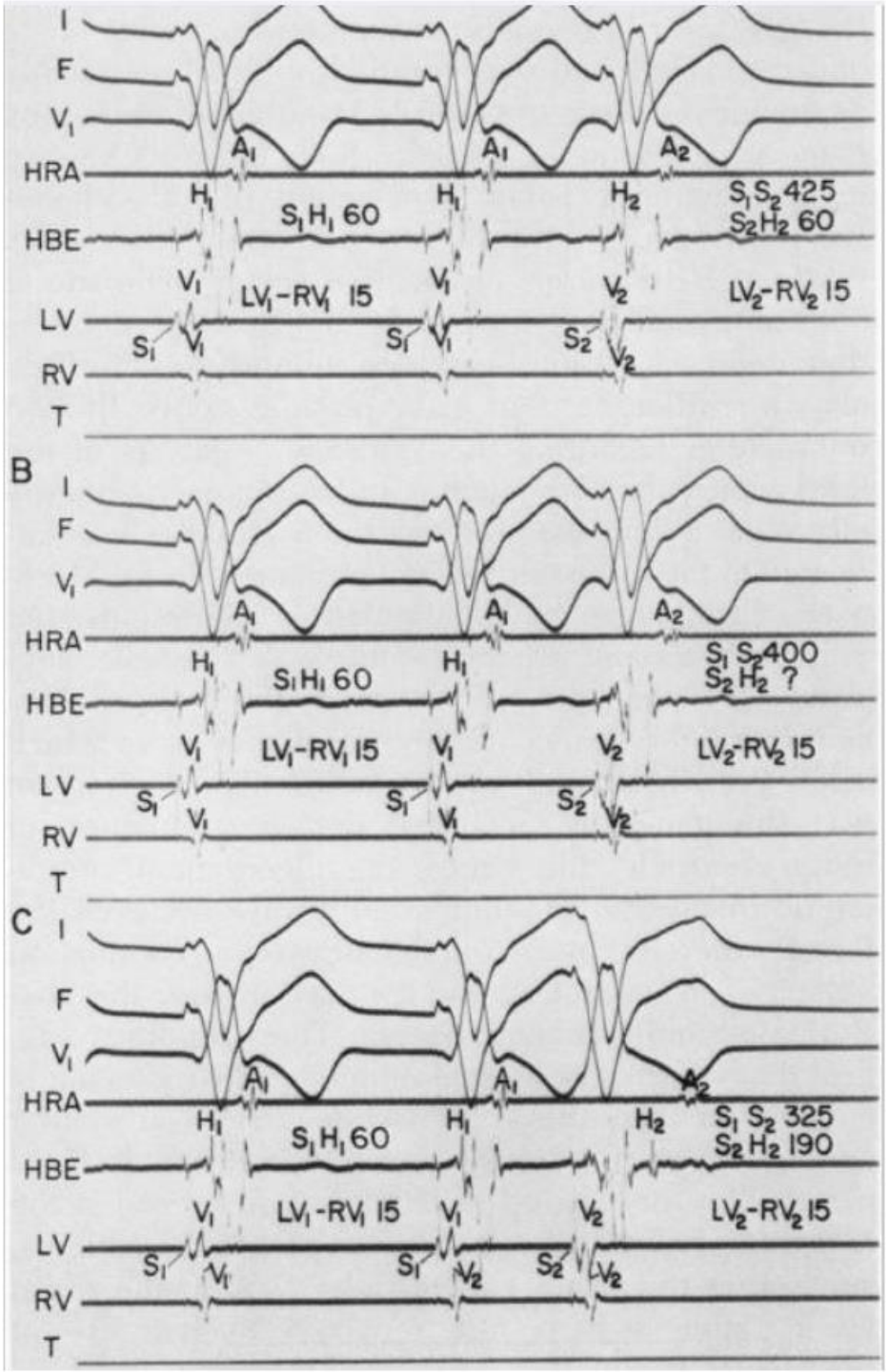
SUMMARY

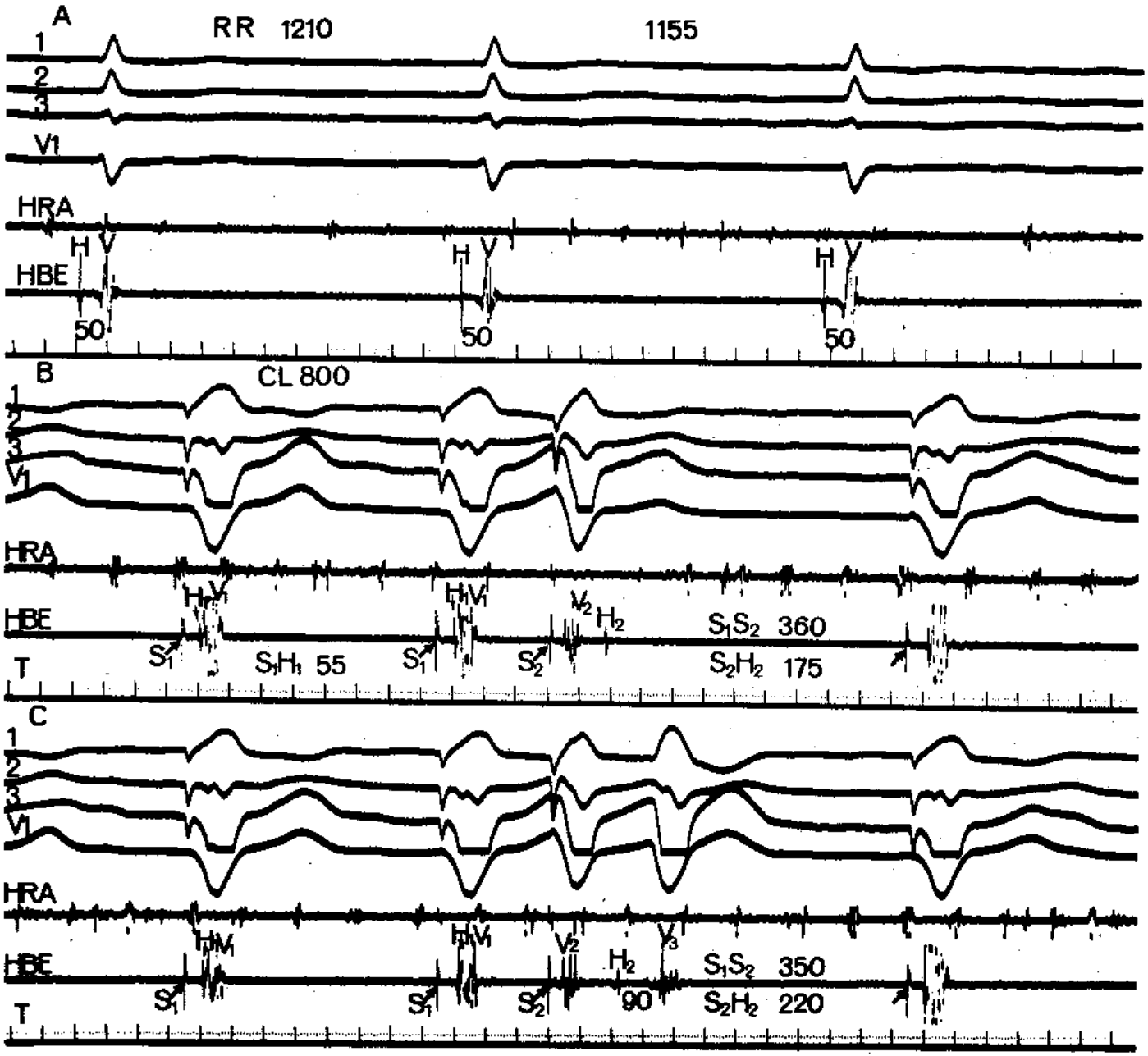
Re-entry within the His-Purkinje system (HPS) was consistently observed in 15/24 consecutive patients in whom retrograde refractory period studies were performed using His bundle electrograms and the ventricular extrastimulus method. Within a narrow range of ventricular coupling intervals ($V_1V_2$), $V_2$ retrogradely conducted to the bundle of His ($H_2$) with significant infra-His bundle conduction delay ($V_2H_2$ interval). At critical $V_2H_2$ delays another beat of ventricular origin ($V_3$) followed $V_2$ and was associated with $H_2V_3$ intervals greater than the H-V intervals of sinus beat. It is postulated that $V_2$ retrogradely blocked within the right bundle branch and activated the bundle of His via the left bundle branch after which antegrade conduction occurred along the right bundle branch producing the $V_3$ response. In support of re-entry within the HPS are the following: 1) $V_3$ occurred in a narrow range of $V_1V_2$ intervals and critical $V_2H_2$ delays, 2) $V_3$ did not occur when $V_2$ retrogradely blocked below the bundle of His, 3) $V_3$ was independent of retrograde A-V nodal delay, 4) $V_3$ rarely occurred in patients with pre-existing complete right bundle branch block pattern. These results reasonably exclude local re-entry near the site of stimulation.

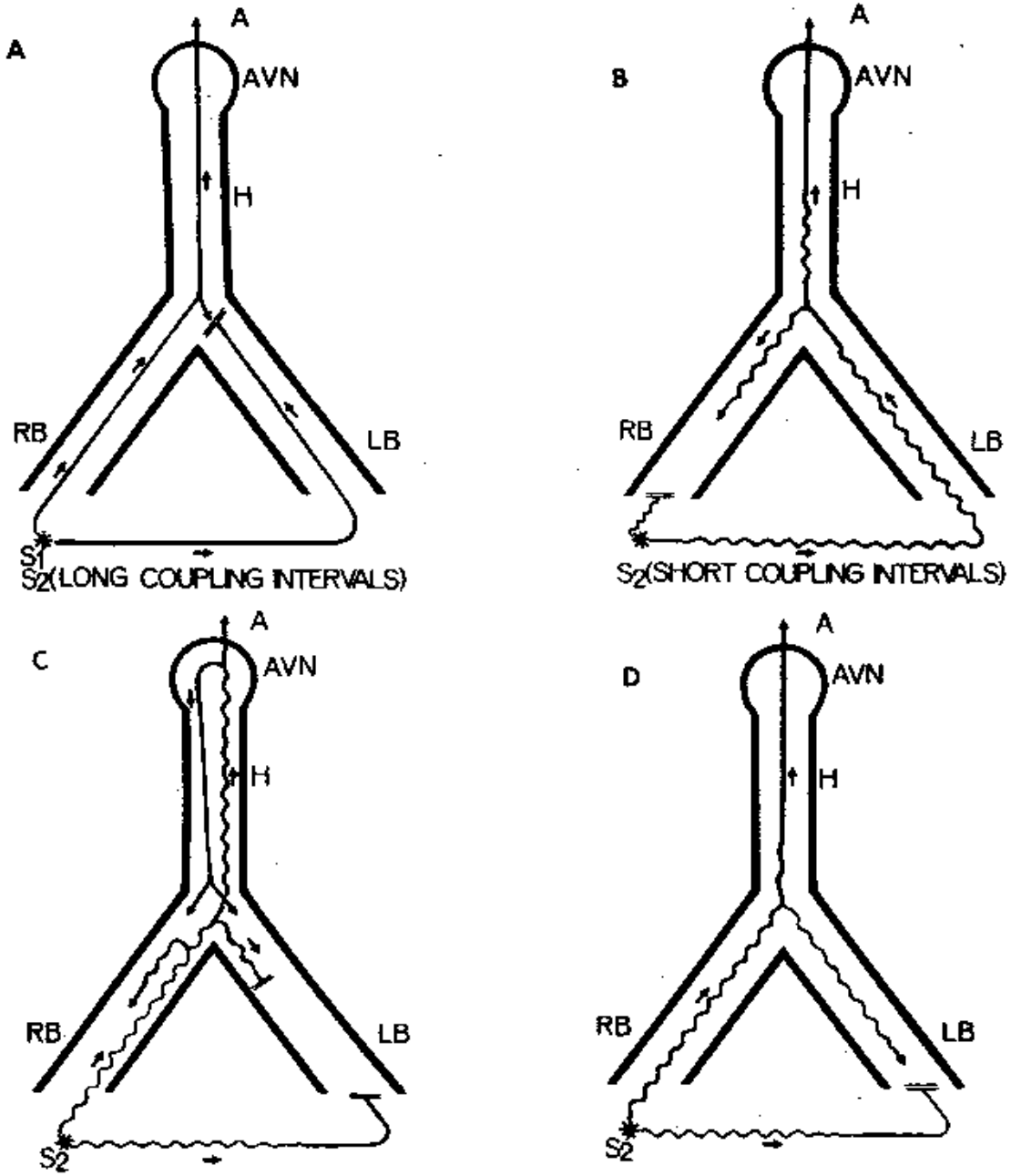
Circulation 1974; 50:1150-62

# Repetitive Ventricular Responses




I
F
V1
HRA
HBE
LV
RV
T
A1
A2
H1
H2
V1
V2
S1
S2
S1H1 60
S1S2 425
S2H2 60
LV1-RV1 15
LV2-RV2 15
B
S1S2 400
S2H2 ?
C
S1S2 325
S2H2 190


A
RR 1210
1155
1
2
3
V1
HRA
HBE
H
V
50
B
CL 800
HRA
HBE
T
$H_1V_1$
$V_2H_2$
$S_1S_2$ 360
$S_1$
$S_1H_1$ 55
$S_2$
$S_2H_2$ 175
C
HRA
HBE
T
$H_1V_1$
$V_2$
$V_3$
$H_2$
$S_1S_2$ 350
90
$S_2H_2$ 220

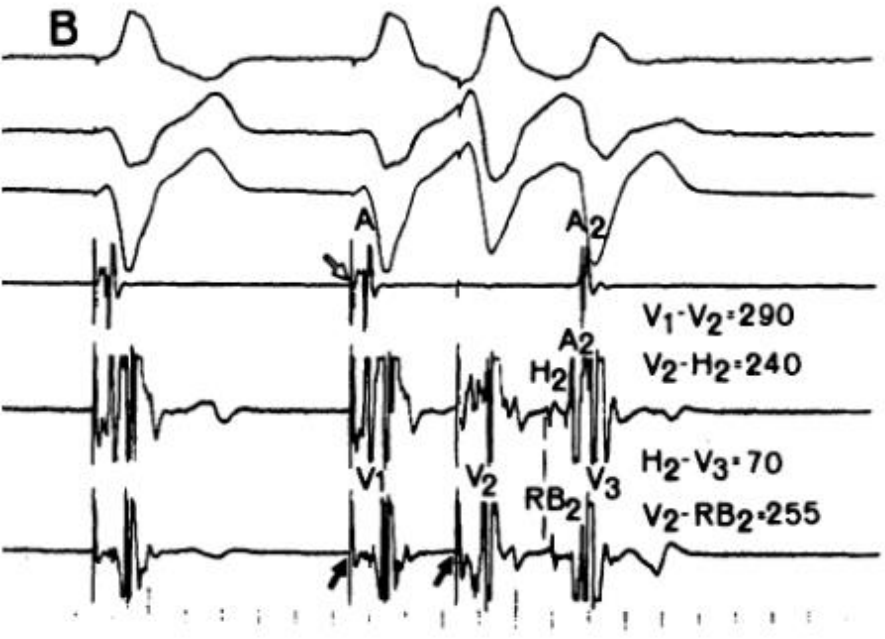

A
A
AVN
H
RB
LB
S1
S2(LONG COUPLING INTERVALS)
A
B
AVN
H
RB
LB
S2(SHORT COUPLING INTERVALS)
A
C
AVN
H
H
RB
LB
S2
A
D
AVN
H
RB
LB
S2

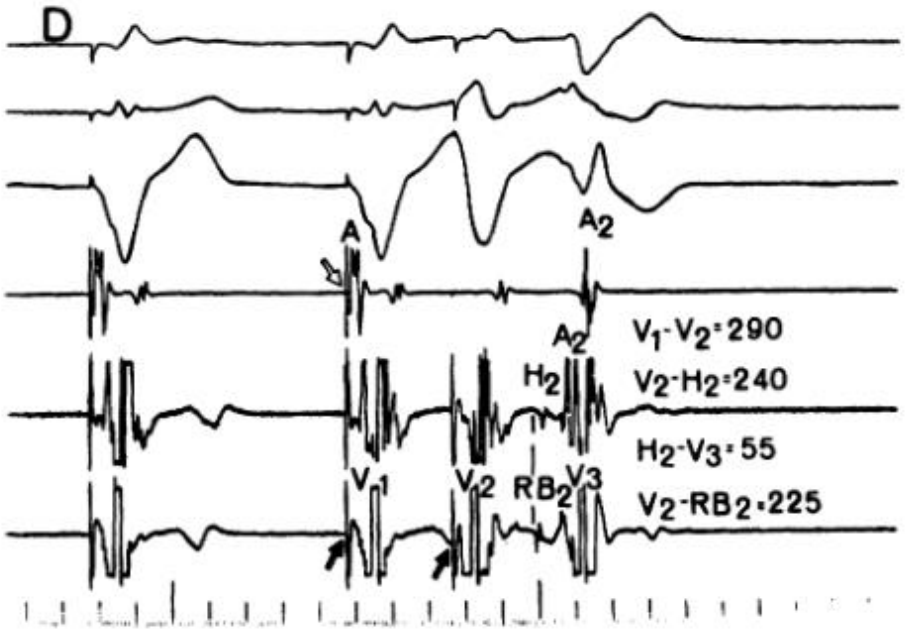
# Circulation

## Reentry within the His-Purkinje system. Elucidation of reentrant circuit using right bundle branch and His bundle recordings.

M Akhtar, C Gilbert, F G Wolf, and D H Schmidt

**Originally published** 1 Aug 1978 | https://doi.org/10.1161/01.CIR.58.2.295 |
Circulation. 1978;58:295–304



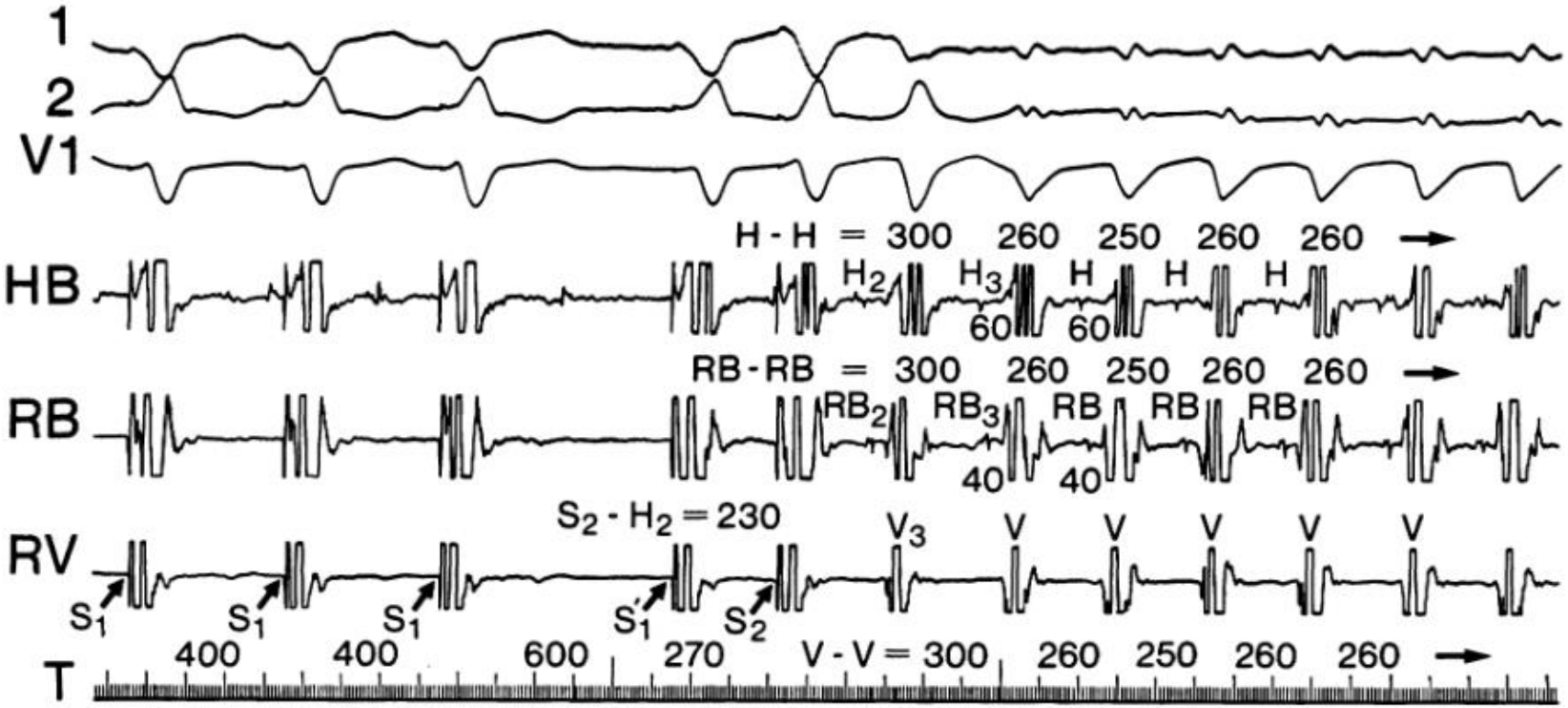



# Circulation

## Sustained Bundle Branch Reentry as a Mechanism of Clinical Tachycardia

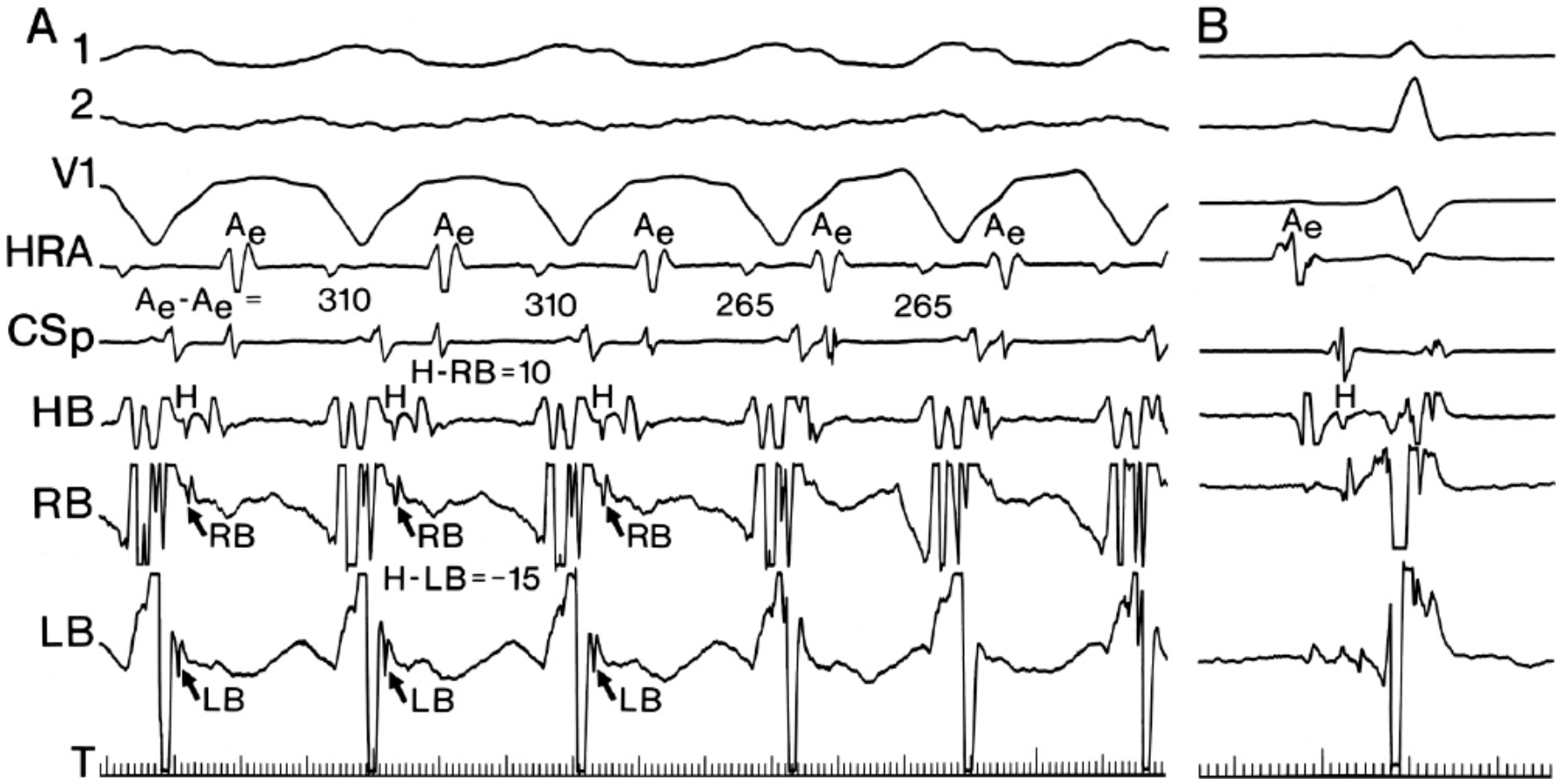
Jose Caceres, MD, Mohammad Jazayeri, MD, James McKinnie, MD, Boaz Avitall, MD, Stephen T. Denker, MD, Patrick Tchou, MD, and Masood Akhtar, MD

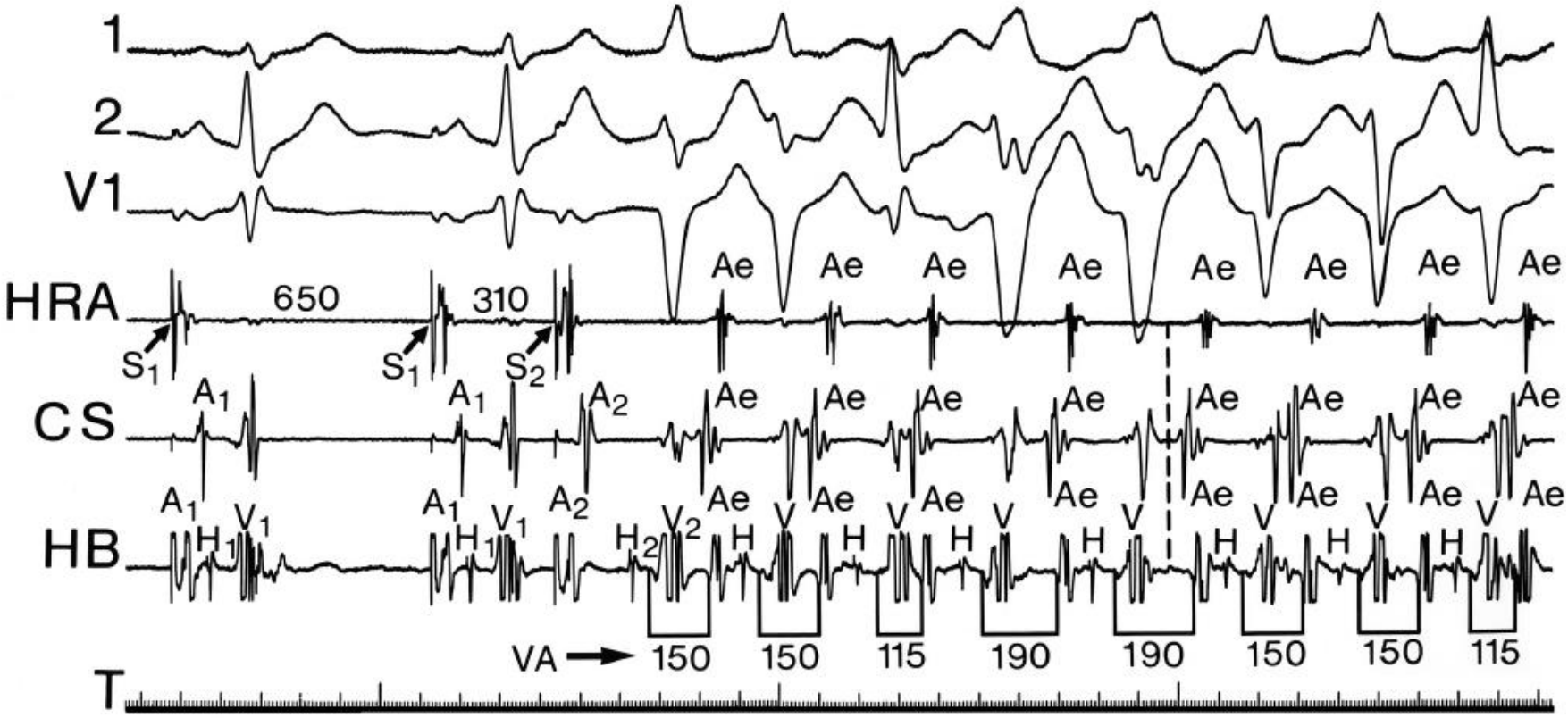
Circulation1989;79:256-270



# Reentry Within the His Purkinje System (Re-HPS/BBR) vs Local Microreentry

- Re-HPS occurs over a narrow range of V1V2 intervals and depends on a critical V2-H2 delay
- Inverse relationship between V2H2 and H2V3
- No evidence of local conduction delay
- Re-HPS never occurs when V2 blocks below the bundle of His
- Re-HPS is independent of retrograde AV nodal delay
- Re-HPS rarely occurs in patients with preexisting RBBB
- Re-HPS is always preceded by a His bundle deflection with HV interval $\geq$ HV in sinus
- These criteria exclude local reentry near site of stimulation


A
1
2
V1
HRA
Ae
Ae
Ae
Ae
Ae
Ae-Ae =
310
310
265
265
CSp
H-RB=10
HB
H
H
H
RB
RB
RB
RB
H-LB=-15
LB
LB
LB
LB
T
B
Ae
H


1
2
V1
HRA
650
310
S1
S1
S2
CS
A1
A1
A2
HB
A1
V1
H1
A1
V1
H1
A2
H2
V2
H
V
Ae
VA
150
150
115
190
190
150
150
115
T

# Masood Akhtar, MD

1943 - 2019