-140-

HEMODYNAMIC BENEFITS OF ATRIOVENTRICULAR SEQUENTIAL PACING DEPEND ON VENTRICULAR DIASTOLIC FUNCTION

Kazuo Komamura, Tohru Masuyama, Atsushi Hirayama, Hiroshi Sato, Shinji Asada, Koichi Taniura, Shinsuke Nanto, Masashi Naka, Kazuhisa Kodama, Yukihiko Koretsune*, Masaaki Uematsu*, Jun Tamai*, Michitoshi Inoue*,

The Cardiovascular Division, Osaka Police Hospital, & *The First Dept. of Medicine, Osaka University, Osaka

The degree of hemodynamic benefits of atrioventricular (A-V) pacing over ventricular (V) pacing differs from patient to patient. In this study, we examined the relation of the increment in stroke volume (ΔSV) by A-V pacing to the parameters of LV function in 20 patients with bradyarrhythmia. Simultaneous measurements of LV pressure by micromanometer during left ventriculography were provided for the determination of parameters of LV function: ejection fraction (EF in %), $+dp/dt$ max (in mmHg/sec), time constant (T in msec) of isovolumic LV pressure fall and stiffness constant (k) of the exponential fit LV diastolic pressure-volume function. EF and $+dp/dt$ max had no correlation with the ΔSV . T and k, however, correlated well with the ΔSV ($r=0.69, 0.83$, respectively). Patients with impaired diastolic function received more advantageous effects by A-V pacing.

Thus, the beneficial effects of A-V pacing over V pacing depend on LV diastolic function rather than systolic function. Parameters of LV diastolic function enabled us to predict the degree of hemodynamic benefits of A-V pacing.

-141-

THE EFFECT OF THE PACING MODES ON THE LEFT VENTRICULAR CONTRACTION AND ISOVOLUMIC RELAXATION IN SICK SINUS SYNDROME

Noboru Mizutani, Hideo Motomura, Yasuhiro Nishiyama, Toshiaki Shiomi, Koya Mizutani, Tadashi Kobayashi and Tsutomu Watanabe.

The 3rd Department of Internal Medicine, Aichi Medical University.

The effect of the various pacing modes on the left ventricular contraction and isovolumic relaxation was investigated in sick sinus syndrome. The subjects of our study were 10 patients. The aortic pressure and left ventricular pressure were measured simultaneously with a dual tip micromanometer. The time constant was analyzed according to the method of Weiss et al.

The left ventricular pressure, aortic pressure, left ventricular maximum($+dp/dt$), mean systolic ejection rate and cardiac output showed a significant increase when the mode was switched from VVI to AAI or DVI mode, but there was no significant difference between the AAI and DVI modes. The Left ventricular maximum($-dp/dt$) increased significantly when the VVI modes was changed for the AAI or DVI mode. The time constant accelerated significantly when changed from VVI to AAI, then to DVI. When changed from DVI to AAI, the time constant slowed down significantly. Wall stiffness, dp/dv , decreased significantly with the change from VVI to AAI or DVI.

The results of our investigation showed that

AAI mode was superior to the other two modes in terms of the ventricular contraction and isovolumic relaxation.

-142-

EVALUATION OF LEFT VENTRICULAR FUNCTION IN PATIENTS WITH VENTRICULAR PREMATURE CONTRACTIONS BY PULSED DOPPLER ECHOCARDIOGRAPHY

Masatsugu Iwase, Mitsuhiro Yokota, Shigehito Takagi, Hu Xiao Jing, Toshio Aoki, Hiroshi Hayashi, Iwao Sotobata

Nagoya University School of Medicine, 1st. Department of Internal Medicine.

The purpose of the present study is to evaluate the left ventricular (LV) functional changes with ventricular premature contractions (VPCs). The subjects consisted of 30 patients with VPCs of unifocal origin, 17 males and 13 females, aged 7 to 68 years. VPCs' pattern consisted of LBBB in 23 cases and RBBB in 7 cases. The LV outflow velocity and inflow velocity were recorded by pulsed Doppler echocardiography with monitoring apical long axis view. To evaluate the hemodynamic changes in LV, percent LV stroke volume of VPC and postextrasystolic beat to sinus beat and percent LV inflow volume of the beat preceding VPC to sinus beat were calculated from these Doppler recordings. VPCs with shorter coupling interval interrupted the preceding rapid filling and smaller LV stroke volume was resulted. VPCs with longer coupling interval made no interruption of the preceding rapid filling and almost the same LV stroke volume as sinus beats was resulted. However, in cases of larger atrial contribution to LV filling (A/F >0.5, 6 cases), a little LV stroke volume of VPCs was observed irrespective of coupling intervals. The coupling intervals significantly correlated with %LV stroke volume of VPCs and %LV inflow volume of the beats preceding VPCs, respectively. A significantly positive correlation was also observed between %LV stroke volume of VPCs and %LV inflow volume of the beats preceding VPCs. Postextrasystolic increase of %LV stroke volume was larger in shorter coupling intervals, but the augmentation of this increase was less sufficient. These findings suggested that the coupling interval of VPCs determined the diastolic filling of preceding beats, which in turn made the stroke volume of VPCs according to the Frank-Starling mechanism.

Chairman

143-148 T. Yaginuma, *Tochigi*
149-154 K. Tsuiki, *Yamagata*
155-159 E. Inooka, *Sendai*

-143-

EVALUATION OF LEFT VENTRICULAR CONTRACTILE RESERVE IN LEFT VENTRICULAR DYSFUNCTION USING POST-EXTRASYSTOLIC POTENTIATION

Masatoshi Nakao, Toshitami Sawayama, Shosho Nezu, Yoritsugu Harada, Motoo Yoneda, Masanobu Samukawa, Kouichi Hasegawa

Division of Cardiology, Department of Medicine, Kawasaki Medical School

Experimental study was carried out if left ventricular reserve function could be determined by evaluating degree of effect of post-extrasystolic potentiation (PESP).

The time sequence of changes in the effect of PESP was studied in the anesthetized dogs with left ventricular dysfunction state induced by microembolization method.

(1) The degree of the effect of PESP on both isovolumic and ejection phase indices of left ventricular function was increased in stage 1 to stage 3, but was decreased in stage 4 (severe dysfunction state) in the same dog.

(2) The reduced effect of PESP in stage 4 may contribute to loss of left ventricular contractile reserve, poor reduction in aortic impedance to ejection and poorly increased diastolic filling.

It is concluded that the observation of the effect of PESP may be useful in the follow-up study in patients with different stages of ventricular dysfunction.

-144-

EFFECTS OF POSTEXTRASYSTOLIC POTENTIATION (PESP) ON THE RIGHT VENTRICLE AND THE RELATIONSHIP TO THOSE ON THE LEFT VENTRICLE

Masaru Yamazoe, Tetsuro Toeda, Yumiko Hoshino, Hirotaka Oda, Fumiaki Masani, Yutaka Arai, Akira Shibata

The First Department of Internal Medicine, Niigata University School of Medicine

The effects of PESP on the right ventricle (RV) and the relationship to those on the left ventricle (LV) were studied during diagnostic cardiac catheterization in 17 patients (31 to 67 years). After micromanometer-tipped catheters were positioned in the ascending aorta and the pulmonary arterial trunk, a single RV premature beat was introduced using an R-wave coupled stimulator. Postextrasystolic changes in the pulmonary arterial and aortic pressures (PAP, AoP) and systolic time intervals were measured.

Results: (1) The systolic PAP increased with PESP in all patients, but the systolic AoP increased in patients with low cardiac performance. (2) In all patients, the RVPEP was shortened (0.111 ± 0.020 to 0.094 ± 0.016 , $p < 0.001$), and the RVPEP/RVET ratio decreased (0.374 ± 0.146 to 0.288 ± 0.068 , $p < 0.01$) with PESP. These changes were greater in patients with low cardiac performance ($r = -0.65$, $p < 0.01$; $r = -0.93$, $p < 0.001$), and similar to those in the LV. (3) There was a relationship between the LV and RV responses with PESP. ($\Delta[\text{LVPEP}/\text{LVET}]$ vs. $\Delta[\text{RVPEP}/\text{RVET}]$, $r = 0.52$; ΔAoP vs. ΔPAP , $r = 0.50$) (4) There was a highly significant correlation ($r = 0.95$, $p < 0.001$) between $\Delta(\text{RVPEP}/\text{RVET})$ and PA resistance.

The effects of PESP on the RV were related to those on the LV and the PA resistance. Thus, with these findings in mind, it can be possible to evaluate RV residual function using PESP.

-145-

SIMULTANEOUS MEASUREMENT OF ACTION POTENTIAL AND CONTRACTION VELOCITY

IN CULTURED CARDIAC CELLS

Nobuhiro Sakata, Noboru Aosaki, Fumitaka Ohsuzu, Haruo Nakamura.

Department of Medicine, National Defense Medical College, Tokorozawa.

Simultaneous measurement of action potential and contraction velocity was successfully performed in cultured fetal heart cells of mouse embryo. This device made it possible to determine the excitation-contraction (E-C) coupling time on single myocyte without effects of innervations and diffusion barriers. Action potential was recorded by microelectrode method and contraction velocity was assessed by using an optical video motion analyzer. Changes in action potential and contraction velocities induced by calcium channel blocker, verapamil, were almost compatible with results of individual experiment previously reported. Preliminary experiment revealed that the E-C coupling time was already elongated to 119% at 10^{-8}M of verapamil with 35% reduction of contraction velocity and a slight decrease in action potential duration and it became almost 200% in 10^{-6}M of verapamil with further reduction of contraction velocity and action potential amplitude compared to baseline values.

These results suggested that newly developed instruments could be applicable to the measurement of E-C coupling time in single cultured myocyte and it might be very much helpful for further evaluation of physiological and metabolic changes of cultured myocyte in cellular levels.

-146-

THE CHANGES OF VISCO-ELASTIC PROPERTIES OF CANINE VENTRICLE UNDER GLOBAL ISCHEMIA

Tadasu Ohyama, Yoshiro Koiwa, Ryoichi Hashiguchi, Takehiko Takagi, Junichi Kikuchi, Takashi Haneda, Tamotsu Takishima*, Takao Murakami, Osamu Ima-izumi**

The 1st. Department of Internal Medicine, Tohoku University School of Medicine*
NEC-SANEI Instrument**

We have developed the impedance frequency curve (IFC) method to detect the instantaneous left ventricular physical properties during the cardiac cycle (ref. 1). In order to clarify the changes of myocardial elasticity and viscosity under global ischemia, we applied this method to the cross-circulated isolated isovolumically-beating canine left ventricle. The coronary perfusion rate was controlled with peristaltic pump (from 100 to 20 ml/min/100gLV in each experiment) to construct the different degree of global ischemia. At each level of coronary perfusion rate the heart was oscillated with the vibrator from 30 to 150 Hz, stepwisely increasing by 4 Hz. The instantaneous value of myocardial elasticity and viscosity were derived from instantaneous IFCs, which was drawn from the output response to the input signal (see ref. 1 for detail). The myocardial viscosity showed much sensitive increase with the coronary flow reduction than the myocardial elasticity. That is, myocardial elasticity showed no significant change until the severe myocardial ischemia of