JACC Vol. 17, No. 2
February 1991:272A

POTENTIAL GRADIENT THRESHOLD NECESSARY TO ACTIVATE HUMAN MYOCARDIUM

J. Marcus Wharton, Timothy Blitchington, Yohannes Afework, Wanda Krassowska, Patrick D. Wolf, William M. Smith, James E. Lowe, and Raymond E. Ideker, Duke Univ Med Ctr, Durham NC

Little is known about the potential gradient field required to directly activate human myocardium. In 8 patients (age 32±7 yrs) undergoing surgical correction of supraventricular tachycardia, myocardial activation and the potential field of the pacing stimulus was measured intraoperatively. A 4.1x4.2 cm plaque containing 121 pairs of silver-silver chloride electrodes and a pacing electrode within the center of the electrode array was placed on the RV anterior free wall at sites not obscured by epicardial fat. The plaque was attached to a computerized mapping system capable of measuring bipolar myocardial activations and unipolar potentials generated by the pacing stimulus. Constant current 40 mA pacing stimuli of 2.0 and/or 0.9 msec were delivered to the center of the plaque in late diastole. Electrodes near the pacing stimuli having no identifiable electrogram were considered to be directly activated (DA) by the stimulus; electrodes having discrete electrograms were considered to be indirectly activated (IA) due to propagation away from the DA sites. Potential gradients were calculated as previously described from the unipolar potential generated by 0.9 msec 40 mA stimuli in all cases. Threshold gradients for DA were determined by gradient value that resulted in the least misclassification of both the number of DA and IA sites. For 2.0 and 0.9 msec stimuli, mean (±SD) threshold gradient was 1.3±0.4 V/cm and 0.8±0.7 V/cm, respectively (p=0.12). Mean percent misclassified DA and IA were 11.2±7.4% and 15.9±0.3%, respectively. Discernable asymmetry to the DA area, as would be expected from an interaction between fiber orientation and field strength, could be seen in only two (20%) of the seven patients. In conclusion, the minimum potential gradient necessary for pacing the human heart is approximately 1 V/cm. There appears to be little effect of fiber orientation on this threshold at the level of the mid RV free wall or the effect is counterbalanced by gradual rotation of fiber orientation intramurally.

SELECTING STIMULUS STRENGTH AFTER CARDIOMYOPLASTY

Frederik H. van der Veen, Caroline Lucas, Roberto Lorusso, Theo van der Nagel, Olaf C. Penn, Hein J.J. Wellens, University of Limburg, Maastricht, The Netherlands

At present no technique is available allowing the determination of the optimal stimulus strength in patients after cardiomyoplasty. Maximal recruitment of muscle fibers is based upon maximally estimated force of contraction of the extra thoracic part of the latissimus dorsi (LD) muscle and stimulus strength is selected accordingly.
To investigate the effect of stimulus strength on LD muscle shortening we implanted Itrel stimulators in 2 goats with the LD muscle in situ. Cardiomyostimulators (SP 100 s) were implanted in 3 goats following routine cardiomyoplasty. During the conditioning period these LD muscles were stimulated at 2.5-4.0 Volts. Animals were studied after 3 months of LD muscle conditioning. At that time LD muscle shortening was measured on X-ray films using the distance between 2 stimulus electrodes.
At low stimulation voltages shortening increased rapidly to reach 13±2% at 2 Volts with a gradual increase to 17±2% at 8 Volts (n = 5). No contraction of the extrathoracic part of the transplanted LD muscle was palpable at values below 2.5 Volts.
Shortening of the LD muscle was also calculated in one patient 4 weeks after cardiomyoplasty using bursts of stimuli (2 Hz; 4 Volts) and in another patient 1 year after cardiomyoplasty (30 Hz; 7 Volts). In between the stimulation electrodes muscle shortening appeared to be 10% in the patient after 4 weeks and 16% in the patient after one year.
Conclusion: Appropriate stimulus strength after cardiomyoplasty should be selected by measurement of LD muscle shortening using the stimulation electrodes.

ATRIAL FIBRILLATION IN DIFFERENT PACING MODES

Franz van Erckelens, Martin Sigmund, Heinz Lambertz, Andreas Kreis, Peter Hanrath; Medical Clinic I, RWTH Aachen, FRG

Compared to normal persons pacemaker patients show a markedly higher incidence of atrial fibrillation (AF) beginning after the implantation. To detect reasons for this phenomenon we retrospectively investigated 265 pacemaker patients (6-241, 99.4 months after implantation; VVI: 163 pts., VVIR: 58 pts, DDD: 44 pts.), who had atrial sinus rhythm at implantation. The influence of the following factors on the occurence of AF was analyzed: time interval after implantation, intermittent intrinsic rhythm vs permanent stimulation and echocardiographically determined right atrial volume (RAV; normal ranges: female: 34±9 ml/m² BSA; male: 41±9 ml/m² BSA).
Results: In 23/163 VVI-paced pts. (14.1%), 2/58 VVIR-paced pts. (3.4%) and 1/44 DDD-paced pts. (2.2%) AF was continously documented. During the first six months after implantation 10/163 VVI-paced pts. (6.1%), 1/58 VVIR-paced pts. (1.7%) and 1/44 DDD-paced pts. (2.2%) developed AF (VVI/VVIR: $p<0.01$; VVI/DDD: $p<0.01$; VVIR/DDD: p=ns).
With reference to normal ranges RAV was significantly larger in the group of VVI-paced pts. with AF (group I) than in group II, 23 matched VVI PM-pts. without AF (121±16% vs 97±18% of normal values; $p<0.05$).
In group I Holter-monitoring revealed less frequently intermittent intrinsic rhythm than in group II (7/23 (30.4%) vs 18/23 (78.3%); $p<0.05$)
No correlation between the time interval after the implantation and the occurrence of AF was to be found.
Conclusion: In comparison to dual chamber pacing and VVIR pacing fixed rate ventricular stimulation implies a higher risk to develop AF. In that regard AV-synchronicity (DDD) and approximation of stimulated ventricular to sinonodal atrial rate (VVIR) appear to be superior to mere VVI-stimulation. Complete pacemaker dependency - at least in the latter group (VVI) - additionally favours the occurence of AF. There is a significant right atrial enlargement in VVI-paced patients with postoperative atrial fibrillation.

Wednesday, March 6, 1991
Poster Displayed: 9:00AM–12:00NOON
Author Present: 11:00AM–12:00NOON
Hall F, West Concourse
Post Transplant Studies

RENAL FUNCTION IS PRESERVED DURING CYCLOSPORINE TREATMENT WHEN ENDOTHELIN IS NOT ACTIVATED.

Margaret Lloyd, Sharon Sandberg, Sarah Schumacher, and Brooks Edwards; Mayo Clinic, Rochester, Minnesota USA

The mechanism(s) of cyclosporine induced nephrotoxicity remain poorly defined. Endothelin (ET) is a potent vasoconstrictor with preferential effects on the renal circulation. It has been postulated that cyclosporine toxicity may be mediated in part by the effects of ET. Kon et al have reported that acute administration of cyclosporine to the rat results in activation of circulating ET with renal vasoconstriction and decreased glomerular filtration rate. Since the dog is resistant to cyclosporine induced nephrotoxicity, we postulated that in this model, chronic cyclosporine would not activate endothelin and therefore renal function would be preserved. Oral cyclosporine (20 mg/kg/day) was administered to dogs (n=4) for seven days. 24 hour urine collections, plasma renin activity (PRA), aldosterone, and ET levels were obtained on days 0 and 7. On day 7, the mean cyclosporine level was 612±177 ng/ml.

	C_{cr} (ml/min)	ET (pg/ml)	PRA (ng AII/ml/hr)	Aldo (ng/dl)
Day 0	44.2±7.8	10.4±0.4	1.54±0.79	6.23±0.55
Day 7	46.0±8.2	8.7±1.6	5.70±0.21*	15.00±2.98

We observed activation of PRA and aldosterone on day 7. Circulating ET and the 24 hour creatinine clearance (C_{Cr}) were unchanged by chronic cyclosporine administration. This study demonstrateds for the first time that in the absence of ET activation, supratherapeutic doses of cyclosporine do not result in renal impairment.