Results: In all cases, the system (1) generated the correct set of electrophysiologic models, (2) eliminated or supported the appropriate models (i.e. rhythm mechanisms) based on the ventricular extrastimulus, and (3) generated ladder diagrams describing the rhythm mechanisms.

Conclusions: This is the first report of a computer-based system capable of deriving differential diagnoses with supporting ladder diagrams from intracardiac electrogram recordings. This demonstrates the potential for automatic analysis of complex rhythms by computer-assisted analysis of intracardiac electrograms. This system may be useful in the clinical electrophysiology laboratory by assisting physicians with the enormous amount of data generated during the typical electrophysiology study.

901-37 Computer Implementation of Wavelet Decomposition of Signal Averaged Electrocardiograms

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Simple spectral analysis of signal averaged electrocardiograms (SAECG) has been the subject of numerous studies. However, the approaches reported so far appear inferior to the gold-standard time-domain analysis of SAECG. At the same time, the limitations of the time-domain analysis are well known and suggest that a more complex spectral analysis of SAECG will be of clinical importance. One of the possibilities for a more complex spectral analysis of SAECG is the so called Wavelet Analysis (WA) which is a time-scale technique suitable for the detection of small transient signals even if they are hidden in large waves. It is obtained by expanding the signal on a set of functions resulting from translation (time) and dilatation (scale) of a so-called "analysing wavelet". WA provides a bidimensional representation of the signal in function of time and scale.

In order to apply WA to SAECG, a special software package written in Borland Pascal has been developed. The WA of the signal s(t) is computed according to the formula $S_g(a,b) = \int_{-\infty}^{+\infty}(1/\sqrt{a})g(t)s(t)\,dt$, where parameter a corresponds to the dilatation and parameter b to the time shift. The package uses the Morlet wavelet $g(t) = \exp(i\omega t)\exp(-t^2/2)$ for $\omega = 5.3$. Empirically, 54 scales were chosen, defined by the scale parameter $a = 40 \times 2^{-m}$, with m ranging from 0.95 to 3.6 with an increment of 0.05. The middle frequencies of the corresponding wavelets range from 250 to 40 Hz. The package processes SAECG files in the standard ART format. To synthesise the information contained within all three wavelet transforms, a wavelet vector magnitude is obtained from the wavelets of three averaged X, Y, Z leads and computed as $WM = (WX^2 + WY^2 + WZ^2)^{1/2}$.

The package has been employed in several studies which showed that (a) WA of SAECG is highly reproducible and (b) selected parameters of WA are superior to the time-domain analysis of SAECG when used for identification of survivors of acute myocardial infarction who are at high risk of sudden death and/or ventricular tachycardia. This comparison of WA and time domain analysis of SAECG used receiver operator and positive predictive characteristics which showed highly significant differences.

901-38 New Image Processing, Segmentation, Extraction and Display Algorithms Allow Easier and More Versatile Dynamic Volume-rendered Three-dimensional Echocardiographic Examination: Application in Experimental and Clinical Studies

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The segmentation and display algorithms available for our previous 3-D echo (3DE) studies were limited, and cutting planes had to be used for displaying specific regions (objects) within the heart. In this study, we explored the potential of newer 3D segmentation, extraction and display algorithms in performing volume-rendered 3DE in 10 dog studies and in 30 clinical studies. Sequential 2D image data for 3DE were collected using tomographic linear slicing, fan-like scanning or rotational imaging modalities with the use of computer-controlled motors, gated to ECG and respiration. The 3DE data matrix obtained from 2DE images of cardiac cycles acquired at 1 mm or 1–2 degrees (over 180 degree span) underwent further processing. Besides developing dynamic 3DE image projections as done in the past, the use of new filtering techniques (low pass, Sigma, anisotropic diffusion), and the new segmentation and extraction software (special contouring, morphing, and Boolean process) enabled us to perform the following: (1) We were able to extract any desired region or part of the heart (original data set), and display it in a dynamic 3D mode, (2) Color-encode the regions of pathology, (3) Change opacification grade of structures such as myocardium (from solid to transparent), (4) Visualize in 3D myocardial regions of selective contrast enhancement following contrast administration, (5) View chambers alone as cavity casts if desired, (6) Display one or more extracted labels (regions) together, side-by-side, or separately, (7) Quantify the volume of any extracted region, and (8) Perform measurements directly on 3D images (which was not possible before). These capabilities allowed us to better delineate and quantify pathology of various types in the clinical studies and aided in the study of myocardial perfusion in experimental studies. Thus the newly developed image processing algorithms increase the clinical potential of 3-D echocardiography.

CORONARY/VASCULAR PHYSIOLOGY — BASIC AND CLINICAL

901-39 Testosterone-induced Coronary Conductance and Resistance Vessel Relaxation In Vivo: Potential Mechanisms of Action

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Although testostone causes relaxation of the coronary vascular bed, its mechanisms of action has not been defined. We examined the effect of intracoronary testosterone (10^{-6} to 10^{-5}M) on epicardial and resistance coronary arteries *in vivo* in 10 dogs (5 male, 5 female). Changes in coronary average peak velocity (APV) were assessed using a 0.014" Doppler guidewire (Cardiometrics), and epicardial cross-sectional area (CSA) was measured using a 4.3F, 30 MHz ultrasound imaging catheter (CVIS). After establishing a baseline response, the contribution of nitric oxide (NO), prostaglandins and ATP-sensitive K^+ channels was assessed. Testosterone induced a significant increase in both CSA and APV at the 10^{-6} and 10^{-5}M concentrations (CSA: 12.6 ± 5.0 and 13.7 ± 8.8%, APV: 53.5 ± 21.9% and 37.8 ± 12.2% at 10^{-6} and 10^{-5}M respectively ($p < 0.01$ in all cases)). Pre-treatment with "Nitro-L-arginine methylester (L-NAME, 100 μM intracoronary) to block NO synthesis decreased testosterone-induced increase in CSA (13.4 vs. 8.0%, $p = 0.06$) and APV (89.4% vs. 39.8%, $p = 0.06$). Pre-treatment with glibenclamide (10^{-5}M) to assess role of ATP-sensitive K^+ channels did not attenuate testosterone-induced dilation in epicardial arteries though it did in the microcirculation (74.8 vs. 32.8%, $p = 0.03$). Pre-treatment with indomethacin (5 mg/kg IV) did not alter changes.

Conclusion: We conclude that acute testosterone-induced conductance coronary vasorelaxation is mediated in part by endothelium-derived NO. In contrast, ATP-sensitive K^+ channels appear to modulate testosterone effects on resistance arteries. The prostanoid system is not involved in either conductance or resistance coronary vascular relaxation.

901-40 Gender-related Differences in Smooth Muscle Cell Proliferation in Response to Estradiol and Dihydrotestosterone

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The cardioprotective effect of estradiol (E_2) is strongly supported by the reduced incidence of coronary artery disease (CAD) observed in premenopausal females versus age-matched males and in postmenopausal females on estrogen therapy. The favorable effect of estrogen on lipid profiles does not fully account for the observed cardiac benefits in females versus males. We have previously demonstrated that physiologic concentrations of E_2 inhibit female pig coronary vascular smooth muscle cells (VSMC) in vitro; this may partially account for estrogen's favorable cardiac effects. We determined the effect of sex steroids [dihydrotestosterone (DHT) and E_2] and tamoxifen (an anti-estrogen) on proliferation of coronary VSMC obtained from male pigs. VSMC were cultured in phenol red-free Media 199 with 10% fetal calf serum. Cells obtained from mature adult male pigs were growth arrested in serum-free media for 24 hours, and treated with effectors in 2% charcoal-stripped serum at concentrations ranging from 10^{-11} to 10^{-7} M for 24 hours. Cell proliferation was assessed by tritiated thymidine incorporation corrected for protein content. No significant effect on proliferation was observed in E_2 or tamoxifen-treated cells versus vehicle controls. Proliferation was significantly increased in cells treated with DHT at 10^{-11} M. In conclusion, E_2 did not inhibit proliferation of coronary VSMC obtained from intact male animals, in contrast to the inhibition observed previously in VSMC obtained from intact female pigs. This gender-related differential response in vitro to E_2 may partially explain the reduction in CAD in estrogen-replete women compared to men. Tamoxifen had no effect on VSMC proliferation. The increased proliferation of VSMC in response to dihydrotestosterone may play a role in the pathogenesis of CAD in males.