P-A6 **ANALYSIS OF MAGNETICALLY-INDUCED POTENTIALS AND CURRENTS AROUND THE ASCENDING AORTA**

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It is important to evaluate quantitatively the induced electrical potentials and currents in the circulatory system when homogenious DC magnetic fields are applied to the body e.g., as in NMR imaging. In fact, it has been reported that electrocardiograms recorded from monkeys change in DC magnetic fields [Bioelectromagnetics 4: 1-9 (1983)].

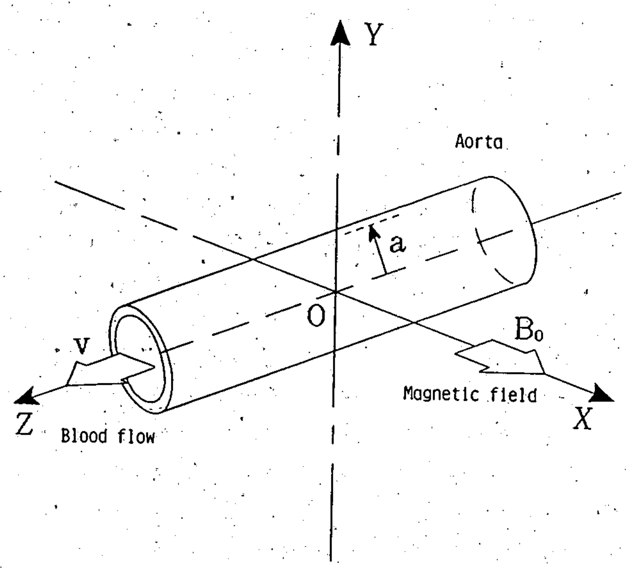
Since the ascending aorta has the largest induced electromotive forces, the potentials and currents induced outside of the aorta were analyzed by a two-dimensional finite element method. The model consists of the aorta and its surrounding tissue at the cross section of the aorta. A simultaneous set of equations that were solved included a blood flow velocity distribution and induced electric fields.

The resulting solution shows that if a one Tesla magnetic field is applied to a body in the thoracic-abdominal direction, the induced potential at the instant of the maximum aortic blood flow velocity (60 cm/s) is about 1 mV on the thoracic surface near the breasts. This induced potential is large enough to be detected in the electrocardiogram.

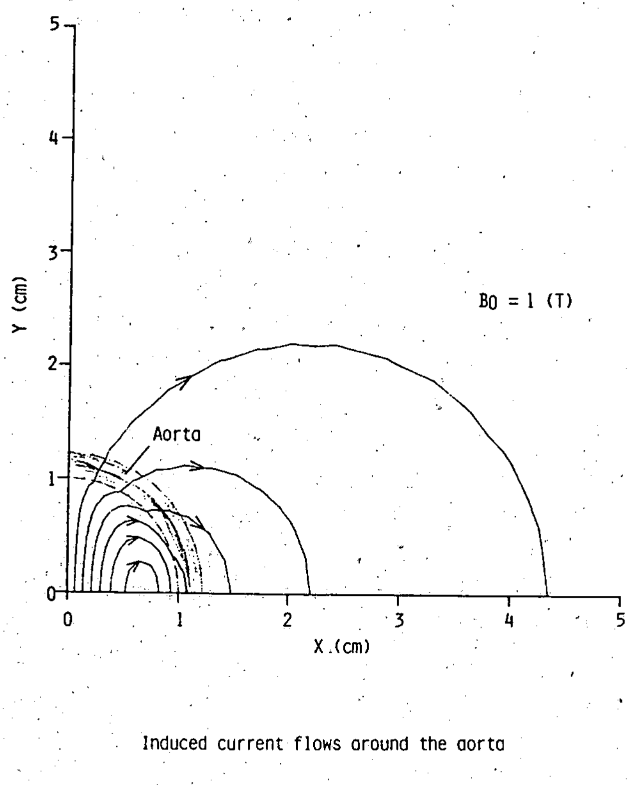
The induced current density under the same exposure conditions is about 0.05 A/m² on the vascular wall and about 0.02 A/m² at a point 1 cm away from the aorta (near the sinoatrial node). These induced current densities are much smaller than the 50% response level for ventricular fibrillation (about 1.7 A/m²).

Typical parameters for a man

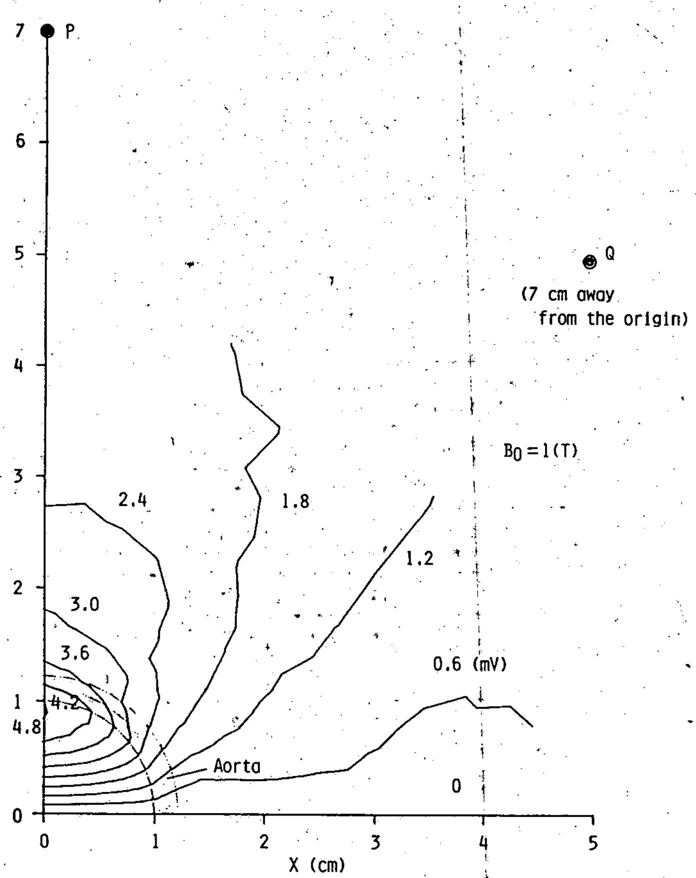
Blood flow velocity (mean)	V_m	60	cm/s
Blood conductivity	σ_b	0.5	S/m
Aorta conductivity	σ_a	0.15	S/m
Surrounding tissue conductivity	σ_t	0.2	S/m
Blood viscosity	η	5	cP
Inner radius of aorta	a	1	cm
Permiability	μ_0	$4\pi \times 10^{-7}$	H/m
Applied magnetic field (Hartmann number $H_a = B_0 a\sqrt{\sigma_b/\eta} = 0.1$)	B_0	1	T



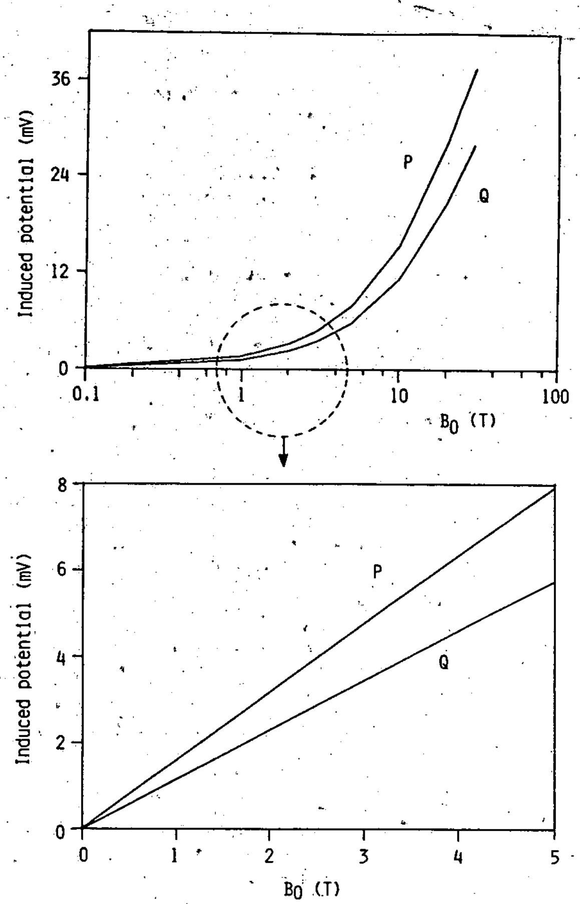
Aorta model in a transverse magnetic field



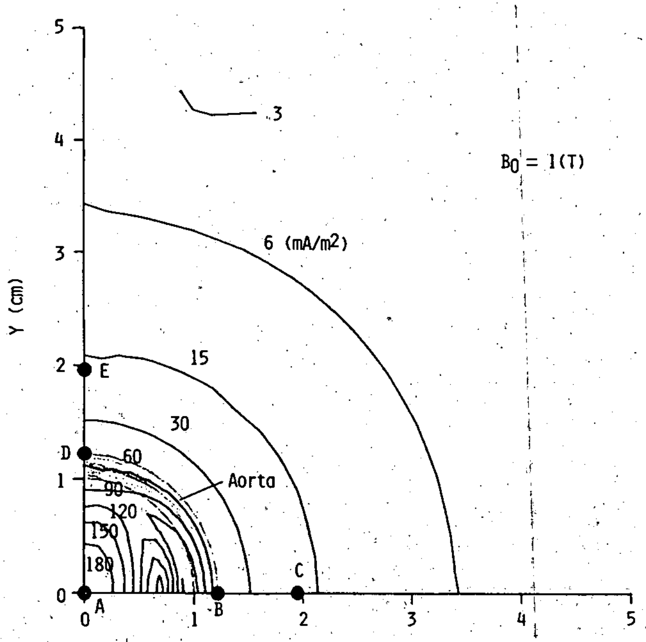
Induced current flows around the aorta



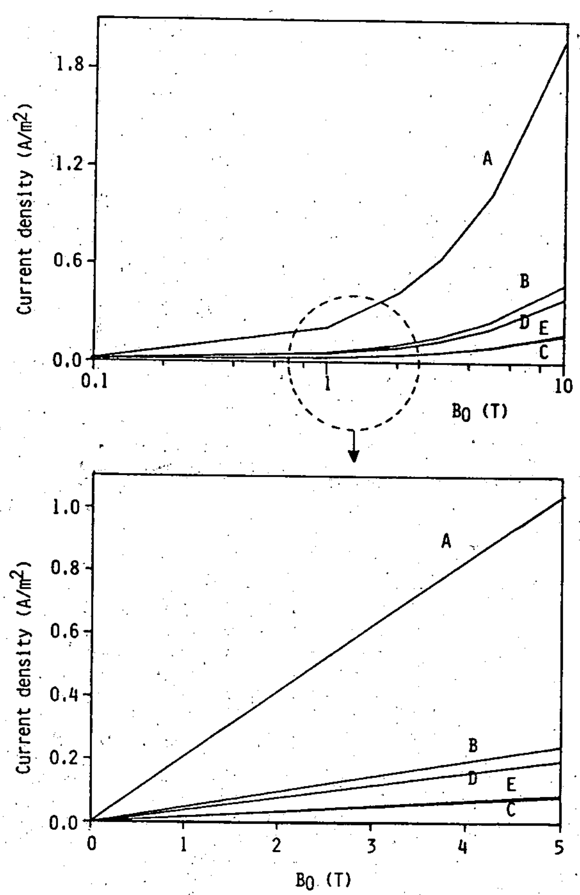
Contour lines of induced potential



Change of induced potential with applied field B_0



Contour lines of induced current density



Change of induced current density with applied field B_0