Title: IMPEDANCE AS AN EARLY MARKER FOR MYOCARDIAL ISCHEMIA
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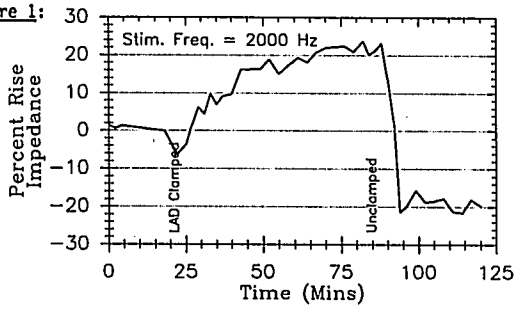
Introduction: Changes in tissue impedance have been shown to correlate with the onset and progression of ischemia in various tissues. In particular, myocardial impedance has the potential to be a sensitive indicator of myocardial damage secondary to ischemia. The purpose of this investigation is to characterize the change in tissue impedance in response to acute coronary artery (LAD) occlusion in dogs. Furthermore, we evaluated the efficacy of measuring myocardial impedance utilizing two standard ventricular pacing electrodes, a technique which may have specific application to open heart surgery.
Methods: After institutional approval, twelve dogs were anesthetized with chloralose, intubated, ventilated, and had arterial and pulmonary artery catheters placed. Median sternotomy was performed to facilitate myocardial exposure. All dogs were anticoagulated with heparin. The LAD was isolated in a distal position so that a discrete area of the left ventricle (ventricular apex) would be rendered ischemic upon LAD occlusion. Impedance was measured by using an AC current at a frequency of 2000 Hz through two standard ventricular pacing leads (Medtronic 6500) placed in the LV apex distal to the LAD ligature. The LAD was occluded with a ligature for a 60 min interval or until impedance was increased 25% from baseline. HR, MAP, mean PAP, wedge pressure, and impedance were recorded at baseline and at 5 min intervals during LAD occlusion. The ligature was then released allowing reperfusion and measurements were taken at 5 min intervals for a total of 60 min.
Results: The characteristic response of impedance to LAD occlusion is shown in Fig 1. The mean increase in impedance during LAD occlusion was 36% with a mean occlusion time of 63 min. Impedance rapidly decreased following reperfusion, with measurements below baseline values for the remainder of the data collection period. HR and MAP were stable throughout the ischemic interval; hemodynamic changes were observed in the reperfusion interval secondary only to ventricular arrhythmias. Mean PAP and wedge pressure were not significantly changed for any dog throughout ischemia.
Conclusion: The impedance response to ischemia is secondary to metabolic and ultrastructural cellular changes in the myocardium. We demonstrated (1) that impedance is both a sensitive and early marker of myocardial ischemia and (2) the efficacy of utilizing ventricular pacing leads to measure impedance. This technique may have particular application to assessing the adequacy of myocardial protection and coronary revascularization during open heart surgery.

Figure 1:



A483

Title: INCIDENCE OF VITAL SIGN ARTIFACT IN AUTOMATED ANESTHESIA RECORDS
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Introduction. By automatically charting vital sign information from primary patient monitors, computerized anesthesia record keeping systems can relieve the anesthesiologist of a large amount of this clerical burden, offering added time for direct patient vigilance. However, the similarly dutiful transcription of *artifactual* data by these devices remains a serious obstacle to the widespread acceptance of this technology. For nearly two years, our cardiac anesthesia division has used a computerized system as the exclusive means of generating anesthesia records. The purpose of this study was to examine the incidence and nature of vital sign artifacts in the these records.
Methods. In August 1988, automated anesthesia record keepers (Arkive® Patient Information Management Systems, Diatek® Inc.) began use in all cardiac surgical operating rooms. Case files, which include vital sign data recorded at a one minute resolution, were transferred to a central database (Oracle, Inc.) using a custom-designed import program ("ArkBase"). During this process, all vital sign data were plotted graphically and examined for the presence of artifact, which appeared as grossly aberrant values (Figure). These points were tagged as erroneous and the entire case data including artifacts were then committed to the database. Every case file was examined in this manner. The database was queried to determine the incidence of artifact for invasive arterial blood pressure (BP), heart rate (HR), central venous pressure (CVP), and oxygen saturation (SaO2). Data from the first two months of operation were compared to those from the most recent two months.
Results. The time required for individual inspection of recorded data using the ArkBase program was 3-8 minutes per case. Table 1 lists for each vital sign the number of individual records processed (#VS), the percentage of case data that was artifactual (%Afct), and the percentage of cases that were found to have no artifact (%Free). These results are grouped by EARLY and LATE study periods. Over this time, there were decreases in %Afct for each vital sign, and SaO2 showed a dramatic improvement. Moreover, %Free nearly doubled for BP and increased to 94% for SaO2.
Discussion. These data demonstrate that the amount of artifactual vital sign data recorded by automated anesthesia record keepers at the outset of their use improved substantially with time and experience with the devices. In recognizing the causes of artifact, such as transducer flushes and electrocautery interference, we have developed means to reduce their impact on the recorded data. These include using alternate locations for pulse oximeter placement and education of the users to limit manipulation of the transducers. In addition, median filtering of continuous data by the recorder and artifact-rejecting features of the monitors ("Smart BP", Marquette) have contributed to this improvement. We conclude that artifact in automated anesthesia records is an addressable, non-threatening issue that does not impact negatively on the use of this technology.

Figure. ***Arterial Blood Pressure Plot*** **artifact (A), cardiopulmonary bypass (CPB) noted**

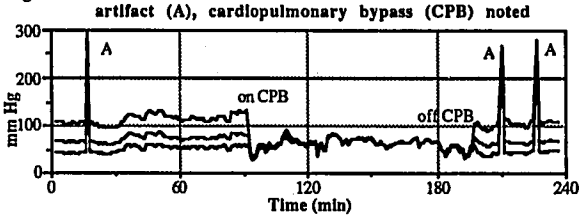

Table 1. ***Incidence of Vital Sign Artifact***

	EARLY: Aug/Sep 1988			LATE: Feb/Mar 1990		
	#VS	%Afct	%Free	#VS	%Afct	%Free
BP	46,450	*2.51%*	**36%**	65,456	*1.46%*	**61%**
HR	47,778	*9.23%*	**21%**	66,732	*3.34%*	**20%**
CVP	41,060	*11.25%*	**4%**	55,240	*5.74%*	**3%**
SaO2	26,481	*3.86%*	**78%**	39,270	*0.10%*	**94%**