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A1005

TITLE: NEURAL NETWORK BREATHING CIRCUIT ALARMS IN AN ANESTHESIA WORKSTATION

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Introduction: We have developed a breathing circuit alarm system based on neural networks using signals from a commercially available anesthesia workstation. This alarm system detects the type and location of breathing circuit faults such as cuff leak, Y piece disconnect, leak in inspiratory hose, expiratory valve stuck closed, etc. A neural network is a data processing method based on mathematical models of physiological reasoning systems. Our neural network was trained to recognize these events after seeing numerous examples of each event.

Methods: The system uses the airway pressure, CO_2, O_2 and expired flow signals available in the Ohmeda Modulus CD anesthesia workstation (Ohmeda, Madison WI). From these signals, 68 descriptive features such as maximum pressure and minimum CO_2 are extracted for each breath. These features form the inputs to the neural network.

Data was collected while ventilating a lung simulator at eight different ventilator and lung compliance settings. Eighty percent of the collected data was used to train the neural network and the remaining 20% of the data was used to test network performance. This process was repeated until all of the data had been used for testing.

Results: The alarm system employed two separate neural networks, one to determine the type of breathing circuit fault and the other to determine the location. For a total of 1,975 breaths, the location of the fault was correctly identified 96.8 % of the time and the type of fault was correctly identified 95.6 % of the time.

Discussion: Our results show that a neural network based alarm system can be trained to function using data from a comercially available anesthesia workstation. We expect that in the near future, anesthesia safety will be improved by incorporation of intelligent alarm systems into anesthesia workstations.

Alarm Location	Alarm Type
96.0% Correctly Identified	95.6% Correcty Identified

A1006

TITLE: Cerebral Perfusion Mapping with Ultrasound Contrast

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Clinically relevant methods for the determination of regional cerebral perfusion has been limited to examination of large arterial (Willisian) flow, small, superficial cortical sites (H_2 clearance or Laser Doppler), or relatively large volumes of heterogeneous tissue with ^{133}Xenon. Albunex consists of microbubbles of air encased in albumin shells with a diameter of 3±4 μm at a concentration of ≈10^8 bubbles/cc. This material is intensely reflective to ultrasound, yet does not appear to embolize tissue or be toxic. This study examines the potential for albunex to be used as a contrast agent to create intraoperative, real-time, high resolution maps of brain perfusion.

With appropriate institutional approval, five juvenile, domestic, female swine were anesthetized, intubated and ventilated. Catheters were placed in the left atrium, and the left common carotid artery (LCCA). A 5MHz near field focus ultrasonic transducer was placed in acoustic contact with the dura via a left parietal craniectomy so as to image a coronal section. Albunex (0.06 cc/kg) was injected in the LCCA during either normocapnia ($P_{ET}CO_2$ = 35mmHg), hypocapnia ($P_{ET}CO_2$ = 20), or hypercapnia ($P_{ET}CO_2$ = 80). Ultrasonic video images were recorded on tape, and analyzed by custom written software for the Macintosh II computer. The software extracted the changes in image pixel intensity between sequential video frames during the injection and washout of albunex and calculated the peak change in intensity, the time until peak change, the transit time and a perfusion index based on Stewart-Hamilton theory.

The contrast effect was apparent in all animals. Cortical, and subcortical grey matter had higher perfusion (darker intensity in figure 1) than white matter. LCCA injection lead to little crossover of contrast to right hemisphere. Perfusion was proportional to $P_{ET}CO_2$(fig 2). Ultrasound examination with contrast injection may be a useful intraoperative diagnostic tool.

Figure 1
Perfusion
MAP

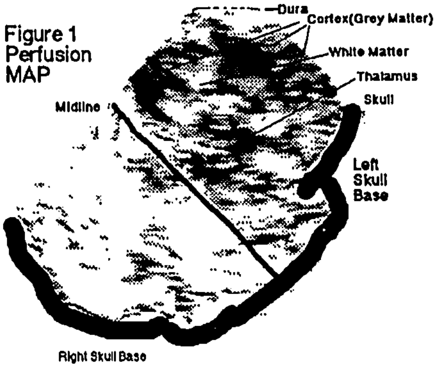

Figure 2